

1078
MATHEMATICS

WE USE

BOOK TWO

**BRUECKNER
GROSSNICKLE**

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GROSSNICKLE**

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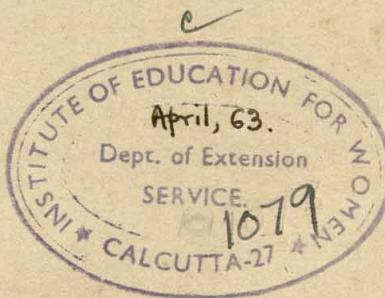
MATHEMATICS WE USE

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BOOK TWO

By

LEO J. BRUECKNER FOSTER E. GROSSNICKLE



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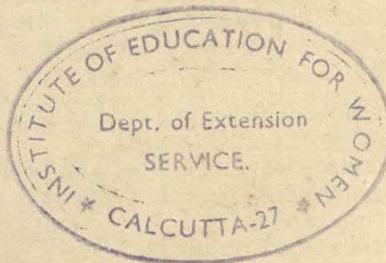
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INTRODUCTION

Basic Plan of the Series. The modern mathematics program recognizes two major phases of the subject; namely, the mathematical phase and the social phase. The purpose of the mathematical phase is to teach the nature of the number system. The purpose of the social phase is to help the pupil to understand and to utilize effectively the quantitative procedures that he will need daily in the social order of which he is a part.

The basis of instruction throughout this series of textbooks is (1) the number system and (2) its social significance. Through carefully planned activities the pupil is taught to understand the nature of the number system. This understanding insures a meaningful grasp of the procedures that are presented in the various computational processes. At the same time the pupil is led to see the social significance of mathematics through the study of rich informational units of work dealing with everyday applications of number processes and quantitative procedures. Also, numerous activities are suggested which require pupils to investigate social applications of mathematics in their own communities. This plan insures a well integrated treatment of both phases of the subject.

Scientific Gradation of Subject Matter. To insure successful growth in mathematics ability, the authors have carefully considered the findings of important investigations of grade placement of mathematics topics, and have made extensive surveys of their own, to determine the most satisfactory points at which to present the various elements of the work. As a result, the work of each grade has been considerably simplified and the teaching load greatly reduced. The easier phases of a topic,—for example, percentage,—are presented one year previous to the introduction of phases known to be more difficult to learn. This scientific gradation of subject matter means that topics are spaced through several grades rather than bunched in any one particular grade.

The major phases of the mathematics processes taught in this book are as follows:

1. Finding a number when a per cent of it is given.
2. Finding volumes of certain solids.
3. Informal geometry of size, shape, and position.
4. Indirect measurement by scale drawing.
5. Ratios and square root.
6. Equations and signed numbers.
7. Social applications of mathematics in such topics as investing money, insurance, and taxation.

Teaching Procedures That Insure Mastery of Mathematics. These textbooks present an instructional program that has been thoroughly tested in hundreds of schools. They provide a systematic step-by-step development of the fundamental operations in such a way that each step is both mathematically meaningful and socially significant. Illustrations, pictures, diagrams, and other kinds of visual aids are extensively used to help the pupils to get an insight into the mathematical meaning of the step being presented.

There are many graphs used in this text. A short chapter is devoted to the study of graphs to instruct the pupil how to read and construct a graph. This phase of the subject represents the mathematical view. In many places in the text a graph is used to interpret the data under consideration. This phase of the subject represents the social application of the topic. The presentation of both the mathematical and social applications of a topic represents a scientific and a psychological approach to the study of mathematics. Besides a psychological approach to the subject, the explanations of procedure are specific and detailed so that the difficulties learners sometimes encounter in the study of mathematics are reduced to a minimum.

Following this concrete development of a step, there are worked-out models for study and solution before practice on the new step is begun. The explanations of procedure are specific and detailed. Diagnostic tests keyed to study helps and remedial practice are provided at frequent intervals to assist the teacher in locating pupils' needs for additional instruction. These tests make it possible for the teacher to provide effectively for individual differences. They also insure intelligent cooperation by the learner toward the correction of any difficulties he may encounter. The skills that have been taught are frequently reintroduced in the units of problem material to insure proper maintenance. Frequent mixed drills of a cumulative nature are also provided. The problems illustrating the applications of the processes are stated in simple language that pupils understand.

Analysis of the Features of the Series. To assist teachers and members of textbook committees in their use and evaluation of this textbook, the detailed analysis of features given below is provided. Similar analyses for the other books of the series are included in each textbook. In instances where the number of page references that might be given is very large, only typical pages are listed. The reader should consult the index for additional details.

1. Consumer mathematics

- a. Problems relating to wise purchasing: 15, 17, 19, 57, 82, 109, 134, 135, 160, 161, 167
- b. Problems relating to business practices: 57, 79, 80, 83, 84, 106, 107, 108, 112, 115, 116, 118, 119, 131, 147, 148, 172, 173
- c. Problems relating to investing money: 105, 108, 125, 127, 132, 140, 141, 142, 143, 144, 149
- d. Problems related to budgeting: 76, 81, 163, 182, 183, 184, 185

2. Correlations with other areas of curriculum

- a. Social studies: 52, 63, 64, 68, 69, 76, 92, 97, 98, 134, 135, 136, 163, 168, 181, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 213, 234, 238, 256
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- d. Safety: 36, 94, 96, 170
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3. Meaningful mathematical development of number processes

- a. Consideration of the nature of the number system as such: 13, 24, 26, 27, 28, 30, 70, 187
- b. Each new step presented in a social setting
 - (1) Finding a number when per cent given: 73, 74, 75, and others
 - (2) Finding ratio of numbers: 247, 248, 249, 250, 251, 253, 255
 - (3) Finding square root: 261, 262, 263, 264, 266, 267, 268, 269
 - (4) Finding indirect measurements: 257, 258, 259, 260

c. Opportunity for finding errors in process: 9, 16

- d. Practice exercises for maintenance of processes learned: 39, 45, 85, 103, 119, 129, 150, 169, 193, 199, 230, 243, 271

4. Development of power to apply quantitative procedures

- a. Activities requiring applications to new situations: 20, 40, 44, 46, 70, 100, 148, 160, 161, 206, 208
- b. Pictures and illustrations to be discussed: 34, 40, 44, 48, 50, 90, 126, 137, 138, 146, 155, 164, 165, 168, 170, 174, 190, 191, 194, 195, 197, 203, 204, 222, 224, 225, 233, 238, 258, 259, 278, 286, 287
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- d. Vocabulary reviews: 85, 121, 151, 176, 198, 218, 271

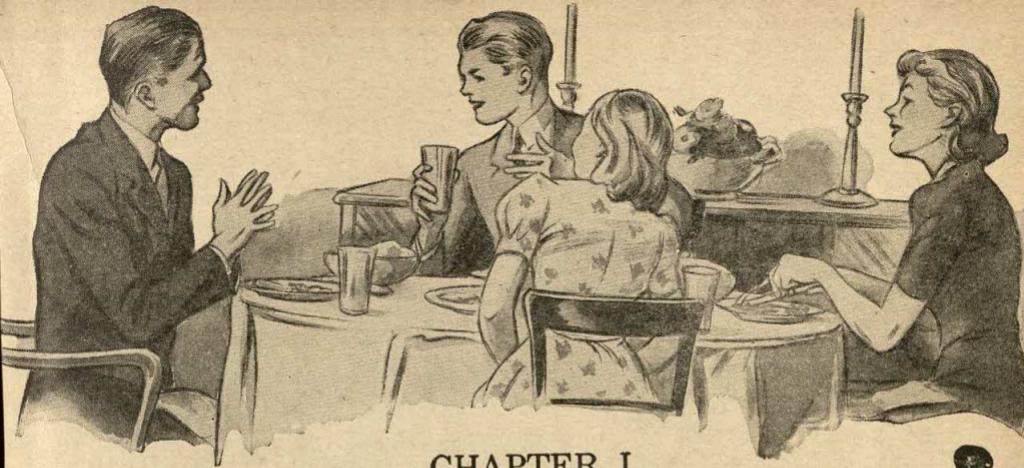
5. Testing program

- a. Inventory test: 6
- b. Diagnostic review tests to locate specific needs: 8, 9, 12, 14, 16, 18, 20, 21
- c. Diagnostic test geared into the new developmental work: 25, 58
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 - h. Tests on chapters: 33, 55, 87, 102, 123, 153, 178, 201, 220, 245, 272, 291
- 6. Adaptation of instruction to individual differences
 - a. See comprehensive testing program outlined under 5.
 - b. Tests, study helps, and practice exercises for individualizing review at beginning of year (see 5a and b): 22, 23
 - c. Starred problems and activities for enrichment and for the more able pupils: 4, 5, 13, 16, 19, 20, 26, 29, 30, 31, 36, 37, 38, 39, 41, 42, 45, 47, 49, 51, 52, 53, 62, 63, 64, 67, 69, 70, 71, 72, 75, 77, 84, 93, 94, 97, 107, 109, 110, 115, 117, 118, 120, 131, 133, 140, 141, 143, 148, 168, 183, 185, 203, 205, 206, 208, 209, 214, 225, 227, 228, 229, 237, 242, 249, 251, 252, 262, 264, 266, 276, 277, 281, 283, 284, 285
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CHAPTER I

MATHEMATICS IN THE NEWS

During the evening meal, the Taylor family usually discusses things of interest which have happened during the day. One night Henry brought up a question which had been asked in his arithmetic class.

HENRY: "If you were to drive your car from one town to another and you did not know the distance between the two towns, how could you find the **approximate** distance?"

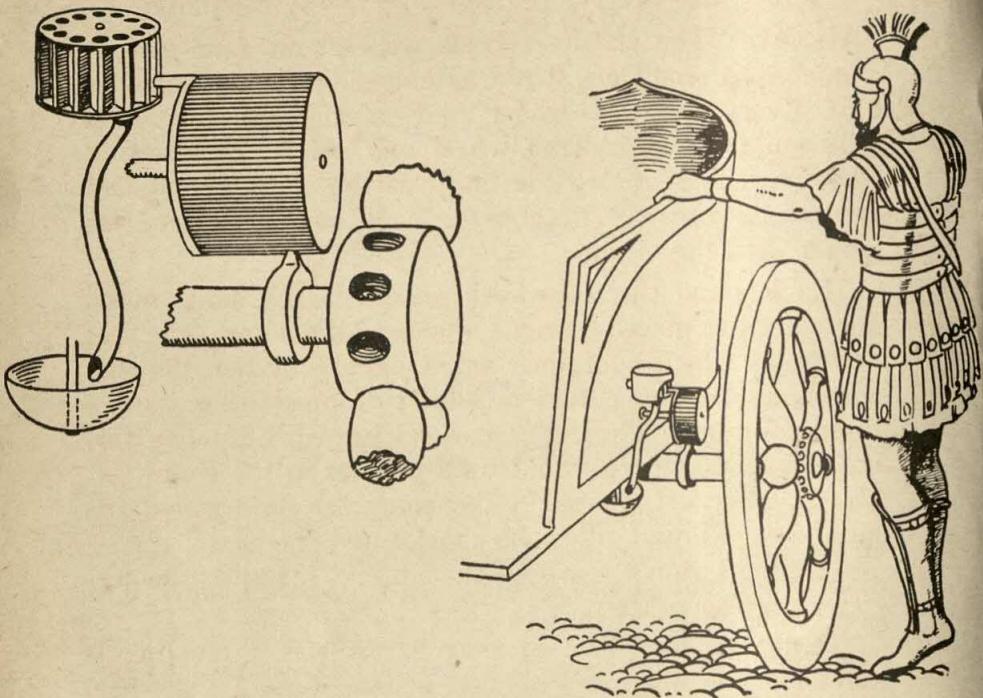
ALICE: "That's easy. I would set the speedometer at zero before starting and measure the distance."

MOTHER: "I would find the distance from a road map."

FATHER: "You have mentioned the best ways: but I could **estimate** the distance. I drive at an average speed of 35 miles an hour, so I would multiply that rate by the length of time spent in going from one town to the other."

HENRY: "We mentioned all of those methods in class and we had some others none of you has given."

Name other ways to find the distance between two places.



THE SPEEDOMETER IS BORN

FATHER: "Let me ask you something. How did the ancients, the Romans for example, measure distances? They had no automobiles or speedometers."

HENRY: "This will surprise you. Jack brought in a news item which showed that the Romans used a speedometer. They called it an **odometer**. The name means 'measure the way.'"

MOTHER: "That is very interesting. I thought the speedometer was invented soon after the automobile. The Romans must have used theirs on some other vehicle, probably the chariot. Tell us what it was like."

HENRY: "The chariot wheels were about four feet in diameter. A small metal rod extended vertically from the hub. Every time the wheel made a complete turn, this rod would move another wheel one notch. This second wheel was fastened to the body of the chariot, and had around its rim 400 notches or cogs, one of which was longer than the others.

"Each time the cogwheel revolved, the long notch moved a disc placed at right angles to the wheel. The disc had holes which contained small pebbles. When the disc wheel moved one notch, a pebble dropped from it to a small container. Thus, if the wheel turned 8 notches during a journey, there would be 8 pebbles in the container. The number of pebbles in the container represented the number of Roman miles the chariot had traveled."

ALICE: "I don't see how that would measure the distance very accurately."

HENRY: "The wheel of the chariot was 4 feet in diameter. The distance traveled in one turn of the wheel would be a little more than three times the diameter or about $12\frac{1}{2}$ feet.

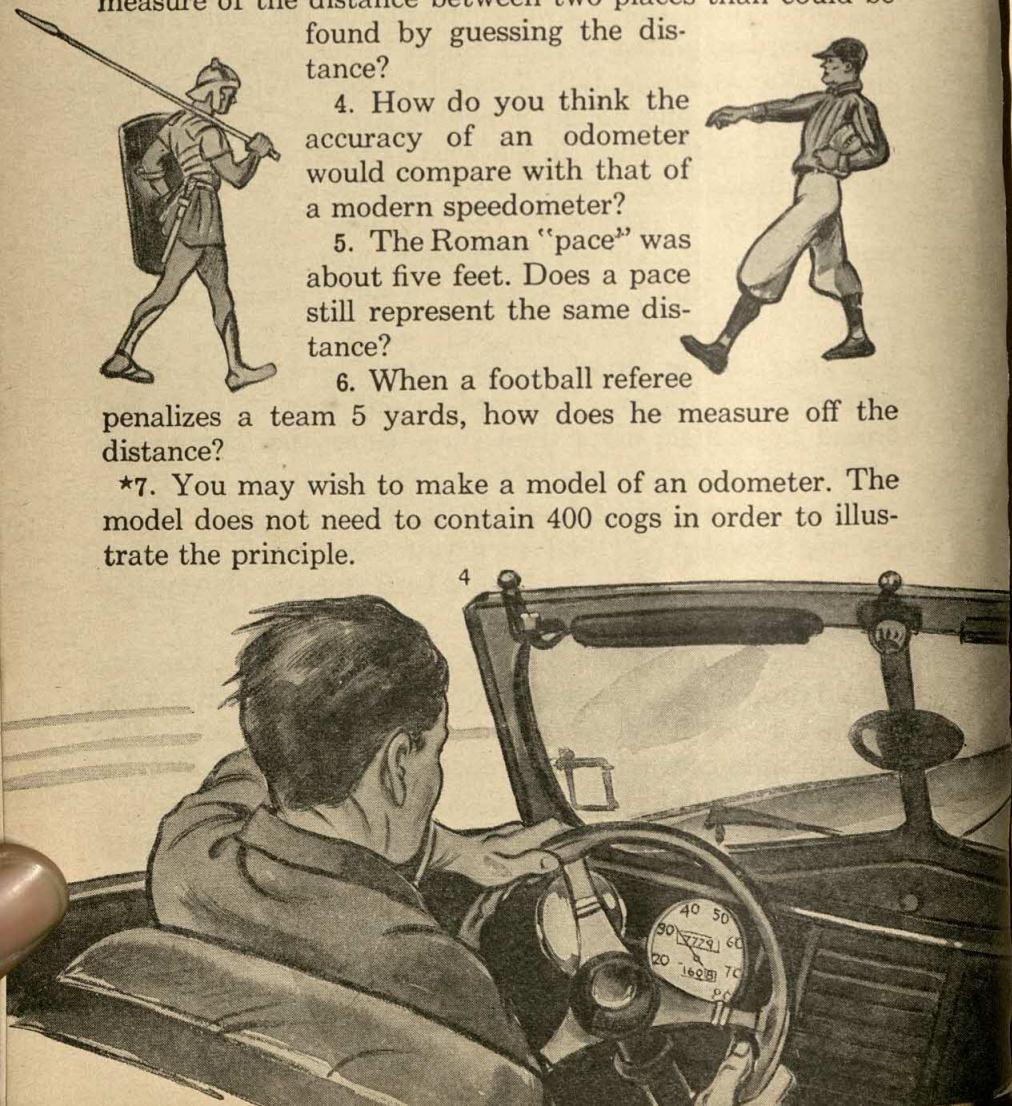
"The second wheel had 400 notches or cogs. As the chariot traveled $12\frac{1}{2}$ feet each time one notch moved, a complete turn of the cogwheel meant that the chariot had traveled 5000 feet ($400 \times 12\frac{1}{2}$).

"Every time the chariot was driven 5000 feet, the disc would drop a pebble into the container. Thus each pebble showed that the chariot had traveled 5000 feet. The Roman mile contained 1000 paces, or about 5000 feet."

FATHER: "That was an interesting lesson. It makes one realize how arithmetic helps us to understand things which we discuss or read."

MEASURING BY ODOMETER

1. Why was the diameter of the large wheel multiplied by a number a little greater than 3?
2. Was the distance the chariot wheel traveled in one complete turn exactly $12\frac{1}{2}$ feet? Explain.
3. Would the odometer give a more, or less, accurate measure of the distance between two places than could be found by guessing the distance?
4. How do you think the accuracy of an odometer would compare with that of a modern speedometer?
5. The Roman "pace" was about five feet. Does a pace still represent the same distance?
6. When a football referee penalizes a team 5 yards, how does he measure off the distance?
- *7. You may wish to make a model of an odometer. The model does not need to contain 400 cogs in order to illustrate the principle.



THE SPEEDOMETER FOR ACCURACY

The speedometer measures distance reasonably accurately to one tenth of a mile. The odometer measured only to the nearest mile. This improvement in measurement was made possible by the use of machinery which can make instruments having more space-divisions to a unit.

Instead of one division, or pebble, to a mile, the modern speedometer measures a unit of length one tenth as great. And the speedometer is more nearly exact than the odometer because of better tools and machines used in constructing the parts of the speedometer. As more accurate means for measuring are invented, a more nearly perfect product is possible.

1. What is meant by measuring to the nearest mile? to the nearest tenth of a mile? to the nearest foot? to the nearest inch?
2. Give these measurements correct to the nearest whole unit of measure: *a.* $6\frac{3}{4}$ ft.; *b.* $8\frac{7}{8}$ yd.; *c.* $2\frac{1}{4}$ in.; *d.* $6\frac{1}{2}$ gal.; *e.* $7\frac{2}{3}$ yd.; *f.* $1\frac{3}{5}$ ton; *g.* $4\frac{3}{8}$ oz.; *h.* $9\frac{7}{10}$ mi.
3. What is the total mileage recorded by the speedometer (page 4)?
4. What is the exact trip mileage? the trip mileage to the nearest mile?
5. At what speed was the car traveling? How much less than the speed limit in your state is this?
6. If "miles an hour," as recorded on the speedometer, is the average speed at which this car is driven, what was the driving time for the trip (to the nearest hour)?
- *7. Name five jobs in which a high degree of accuracy in measurement is required.
- *8. A salesman, demonstrating an automobile, spoke of it as "mechanically perfect." What did he mean?

HOW WELL DO YOU USE THE TOOLS OF ARITHMETIC?

Numbers are sometimes called the tools of arithmetic. This test gives you a chance to measure your understanding and use of these tools.

First copy the examples, leaving plenty of space for your work. You will be allowed 15 minutes to work the examples after they have been copied.

1. $9\frac{7}{8} + 4\frac{3}{4} + 1\frac{1}{2}$
5. $.405 - .389$
2. $9\frac{5}{6} + 4\frac{1}{2} + 8\frac{2}{3}$
6. $8.75 - 3.67$
3. $9\frac{1}{6} - 4\frac{3}{4}$
7. 307×608
4. $71\frac{3}{4} - 16\frac{3}{8}$
8. $4\frac{5}{6} \times 48$
9. $468 + 736 + 509 + 674 + 925 + 780$
10. Find the sum of: .98, .85, 3.75, 97.00, .09, and .72.
11. Multiply $51\frac{7}{8}$ by $4\frac{3}{4}$.
12. How much is 8.75×9.6 ?
13. Multiply $4.56 \times .08$.
14. Divide 9125 by 16. Check your work.
15. How much is $4\frac{1}{2} \div 6$?
16. Divide $3\frac{1}{3}$ by $1\frac{1}{3}$. Check your work.
17. How much is $4158 \div .09$?
18. Divide .0756 by 2.7.
19. $25\% \text{ of } 675 = ?$
20. $75 = ? \% \text{ of } 225$

What Your Scores Mean (Number correct)

Unsatisfactory	Fair	Good	Excellent
Less than 15	15-17	18 19	20

If you made an error on any kind of example in this test, you should take the diagnostic test in that process to find if you should review the process.

HOW TO USE THE DIAGNOSTIC TESTS

The diagnostic tests that will help you to find the practice which you need in the different processes are listed by page number below.

	WHOLE NUMBERS	FRACTIONS	DECIMALS
Addition	Page 8	Page 14	Page 20
Subtraction	" 8	" 14	" 20
Multiplication	" 9	" 16	" 21
Division	" 9, 12	" 18	" 25

The diagnostic tests in percentage are on page 58.

Follow carefully the directions given for each diagnostic test. A good plan is to try all the tests. You may find some part of a process that you should review even though you made no error in that process on the test, page 6.

MAGIC SQUARES

A magic square, as you recall, is made by arranging numbers in a square in such a manner that the sum of the numbers in each row, each column, and along each of the diagonals is the same.

The magic square shown is very famous. It is found on a painting entitled MELANCOLIA, by Dürer.

1. What is the sum of the numbers in each row? in each column?

2. The numbers along one diagonal are 16, 10, 7, and 1. What is their sum? What is the sum of the numbers along the other diagonal?

3. How many cells (small squares) are in the magic square?

16	3	2	13
5	10	11	8
9	6	7	12
4	15	14	1

DIAGNOSTIC TEST IN ADDITION

Do not copy the examples on this page. Write each sum on a folded paper placed beneath the example.

	<i>a</i>	<i>b</i>	<i>c</i>		<i>a</i>	<i>b</i>	<i>c</i>
I.	4	7	3		269	515	289
	8	6	8		471	720	870
	5	9	5		118	124	692
	7	4	9		304	309	802
	9	5	4		760	210	926
	<u> </u>	<u> </u>	<u> </u>		<u>735</u>	<u>462</u>	<u>524</u>
II.	46	79	86		IV.	559	708
	38	56	53			66	6
	95	83	40			955	1423
	67	49	98			38	56
	48	85	39			694	341
	<u> </u>	<u> </u>	<u> </u>			<u>87</u>	<u>3486</u>
							<u>401</u>

If you missed more than one example in any of the four groups, turn to pages 295-296 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN SUBTRACTION

Write on folded paper placed below the example.

	<i>a</i>	<i>b</i>	<i>c</i>		<i>a</i>	<i>b</i>	<i>c</i>
I.	744	563	328		IV.	723	812
	<u>228</u>	<u>127</u>	<u>165</u>			<u>48</u>	<u>9</u>
							<u>7</u>
II.	723	916	835		V.	6703	9130
	<u>156</u>	<u>278</u>	<u>496</u>			<u>6507</u>	<u>8690</u>
							<u>7250</u>
							<u>6308</u>
III.	640	406	702		VI.	7000	6030
	<u>308</u>	<u>198</u>	<u>305</u>			<u>1392</u>	<u>492</u>
							<u>5010</u>
							<u>19</u>

If you missed more than one example in any group, turn to pages 296-297 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN MULTIPLICATION

Turn to page 295 and check your knowledge of the multiplication facts before you take the following test.

	<i>a</i>	<i>b</i>	<i>c</i>		<i>a</i>	<i>b</i>	<i>c</i>	
I.	324	647	519		IV.	457	706	6004
	8	7	6			203	504	308
II.	605	609	9008		V.	870	910	490
	4	9	5			950	460	520
III.	641	738	549		VI.	\$2.75	\$5.98	974
	20	60	30			482	576	493

If you missed more than one example in any group, turn to pages 297-298 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN DIVISION

Divisor—One-Figure

Turn to page 295 and check your knowledge of the 90 even-division facts before you take the following test.

	<i>a</i>	<i>b</i>	<i>c</i>		<i>a</i>	<i>b</i>	<i>c</i>	
I.	7)863	4)2613	5)927		III.	6)3613	4)720	2)5900
II.	7)4031	9)2303	8)5102		IV.	6)2761	7)5100	6)7205

If you missed more than one example in any group, turn to pages 298-299 for practice exercises keyed to this test.

CHECKING DIVISION

1. Divide 4062 by 7 and check the solution by two different methods.
2. Walter divided 51,035 by 9. The result was 567 with a remainder of 5. He checked the solution as shown. Where is the error in this check?

$$\begin{array}{r} 567 \\ \times 9 \\ \hline 5103 \\ +5 \\ \hline 51035 \end{array}$$



BASEBALL IN THE NEWS

If you have heard about the great crowds which sometimes attend big-league baseball games, you may have wondered what becomes of all the money taken in from the sale of tickets. There are many heavy expenses connected with operating a big-league baseball team. The following problems will show you some of the items.

1. To operate a big-league baseball team for one year costs about \$525,000. The players' salaries total about \$250,000. What part of the cost is the players' salaries?
2. A big-league team has 154 scheduled games each season. Half of this number are played at home. The other half are distributed equally among the seven other teams in the league. How many games are played at home during a season? How many are played away from home with each opposing team?
3. It is estimated that the home team gets 70¢ and the visiting team 30¢. from each person who attends a game. If the receipts for the home games played by a team during the season amount to \$350,000, how many persons must have attended these games?

4. What was the average number of persons at each game (problem 3) if the home team was able to play only 75 home games in one season because of rain?

5. There is a government tax of 10% or $\frac{1}{10}$ on the receipts from professional baseball. If the receipts from a game amounted to \$54,873, what was the amount of the tax paid?

6. One major-league team used 5460 baseballs in a recent year. At \$1.25 for each ball, what was the cost of these balls?

7. A major-league team in Chicago used an average of 48 balls in each of its 77 home games. How many balls were used during the entire season?

8. In one of the major-league baseball parks, about 1600 balls were fouled into the stands during the season and kept by the spectators. At \$1.25 each, what was the cost of these balls?

9. A big-league team used 750 bats in one season. If the team played only 150 games, what was the average number of bats used in each game? If the average cost of a bat is \$1.50, find the cost of the bats for each game.

10. The game of baseball was founded by Abner Doubleday in 1839. How many years ago was that?

11. To win a World Series, a team must win 4 games. What is the greatest number of complete games that may be played before one team wins? the least number?

12. Lou Gehrig played in 2130 consecutive baseball games for the New York Yankees. This set a new world's record. At an average of 152 games a season, about how many years did Gehrig play in consecutive games?

13. Gehrig hit 493 home runs in the consecutive games (problem 12). That was an average of about how many home runs each year?

DIAGNOSTIC TEST IN DIVISION

Divisor—Two-or-More-Figures

If there is a remainder in any of the following examples, write it as a remainder, not as a fraction.

a *b* *c*

a *b*

I. 24)576	73)3980	54)872	V. 28)1832	39)2882
II. 24)9631	35)7140	54)5040	VI. 16)9123	17)8534
III. 23)2087	38)3434	56)5072	VII. 324)8147	427)40982
IV. 47)1326	24)1372	48)2175	VIII. 268)13642	158)90970

If you missed more than one example in any group, turn to pages 299–300 for practice exercises keyed to this test.

A TOPSY-TURVY MAGIC SQUARE

Below is a "topsy-turvy" magic square. When the page is held in the usual position or in an inverted position, a magic square is formed.

2673

696	6II	989	668
988	669	69I	6I6
66I	986	6I8	699
6I9	698	666	98I

2964

By Royal V. Heath

UNDERSTANDING LARGE NUMBERS

The symbols used by the ancient Egyptians to represent numbers were not the same as ours. To express a million, they drew a picture of a man, very much astonished. Why do you think that was an appropriate symbol?



1. Find the number of minutes in a year of 365 days. How much more or less than a million is it?
2. How many thousands does it take to make a million? a billion?
3. How many millions does it take to make a billion?
4. What difference, if any, is there between a thousand millions and a billion?
5. What is the largest number which may be written with six figures? the smallest?
6. In some European countries a billion means a million millions. Does it have the same or a different meaning in this country?
7. There are about three quarters of a billion people in North and South America and Europe. A billion dollars would supply each person with about how much money?
- *8. Have as many or more than a billion minutes passed from the beginning of the Christian era to the end of the present year? to the beginning of this century?
- *9. Does your state have a population of more, or less, than a million? How much more or less?
- *10. Astronomers measure the distance to many stars in **light years**. A light year, as you recall, is the distance which light travels in one year at the rate of about 186,000 miles a second. Show that a light year is about six trillion miles. Write this number with figures.

DIAGNOSTIC TEST IN ADDITION OF FRACTIONS

Copy and add the following:

	<i>a</i>	<i>b</i>	<i>c</i>		<i>a</i>	<i>b</i>	<i>c</i>
I.	$\frac{5}{8}$ $\frac{7}{8}$	$\frac{5}{9}$ $\frac{7}{9}$	$3\frac{7}{10}$ $8\frac{1}{10}$	V.	$4\frac{2}{3}$ $5\frac{3}{4}$	$6\frac{1}{2}$ $1\frac{1}{2}$	$7\frac{2}{3}$ $3\frac{3}{4}$
II.	$\frac{3}{4}$ $\frac{7}{8}$	$\frac{9}{6}$ $\frac{5}{8}$	$9\frac{1}{2}$ $4\frac{5}{12}$	VI.	$9\frac{1}{6}$ $1\frac{7}{8}$	$2\frac{5}{6}$ $\frac{3}{4}$	$4\frac{3}{8}$ $1\frac{5}{6}$
III.	$\frac{1}{3}$ $\frac{1}{2}$	$\frac{2}{5}$ $\frac{1}{4}$	$5\frac{1}{5}$ $7\frac{1}{4}$	VII.	$3\frac{5}{6}$ $2\frac{7}{8}$ $9\frac{1}{4}$	$1\frac{2}{3}$ 7 $2\frac{5}{6}$	$1\frac{1}{2}$ $5\frac{7}{12}$ $\frac{3}{4}$
IV.	$\frac{5}{6}$ $\frac{3}{4}$	$\frac{1}{6}$ $\frac{5}{6}$	$6\frac{4}{9}$ $9\frac{1}{6}$	VIII.	$2\frac{5}{6}$ $\frac{7}{8}$ $\frac{3}{4}$	$8\frac{1}{4}$ 9 $3\frac{5}{6}$	$7\frac{1}{4}$ $2\frac{5}{6}$ $3\frac{1}{2}$

If you missed more than one example in any group, turn to pages 300-302 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN SUBTRACTION OF FRACTIONS

Copy and subtract the following:

	<i>a</i>	<i>b</i>	<i>c</i>		<i>a</i>	<i>b</i>	<i>c</i>
I.	$\frac{3}{4}$ $\frac{1}{2}$	$\frac{7}{8}$ $\frac{1}{4}$	$6\frac{9}{16}$ $4\frac{3}{8}$	V.	$9\frac{1}{3}$ $4\frac{2}{3}$	$6\frac{1}{4}$ $2\frac{3}{4}$	$4\frac{2}{5}$ $3\frac{4}{5}$
II.	$\frac{5}{6}$ $\frac{1}{3}$	$\frac{11}{12}$ $\frac{1}{3}$	$9\frac{1}{2}$ $3\frac{1}{12}$	VI.	$9\frac{1}{4}$ $7\frac{7}{8}$	$7\frac{1}{3}$ $2\frac{5}{6}$	$6\frac{1}{2}$ $\frac{5}{8}$
III.	$\frac{5}{6}$ $\frac{1}{4}$	$\frac{3}{4}$ $\frac{1}{3}$	$8\frac{7}{8}$ $2\frac{5}{6}$	VII.	$6\frac{1}{4}$ $2\frac{1}{3}$	$9\frac{1}{2}$ $5\frac{2}{3}$	$7\frac{2}{3}$ $\frac{3}{4}$
IV.	8 $3\frac{5}{9}$	6 $5\frac{7}{8}$	1 $\frac{7}{12}$	VIII.	$15\frac{5}{8}$ $6\frac{5}{6}$	$11\frac{3}{4}$ $8\frac{5}{6}$	$4\frac{1}{6}$ $3\frac{5}{8}$

If you missed more than one example in any group, turn to pages 302-303 for practice exercises keyed to this test.

MARKETING BREAD

1. The United States Department of Agriculture analyzed a 1-pound loaf of bread and found it contained:

Flour, 10 oz.	Water, $4\frac{1}{4}$ oz.
Milk, $\frac{1}{2}$ oz.	Yeast, $\frac{1}{4}$ oz.
Sugar and shortening, $\frac{2}{3}$ oz.	Other ingredients, $\frac{1}{3}$ oz.

What is the weight of all these ingredients?

2. The average price of a 1-pound loaf of bread was $9\frac{1}{2}$ ¢. The cost of making it was distributed as follows:

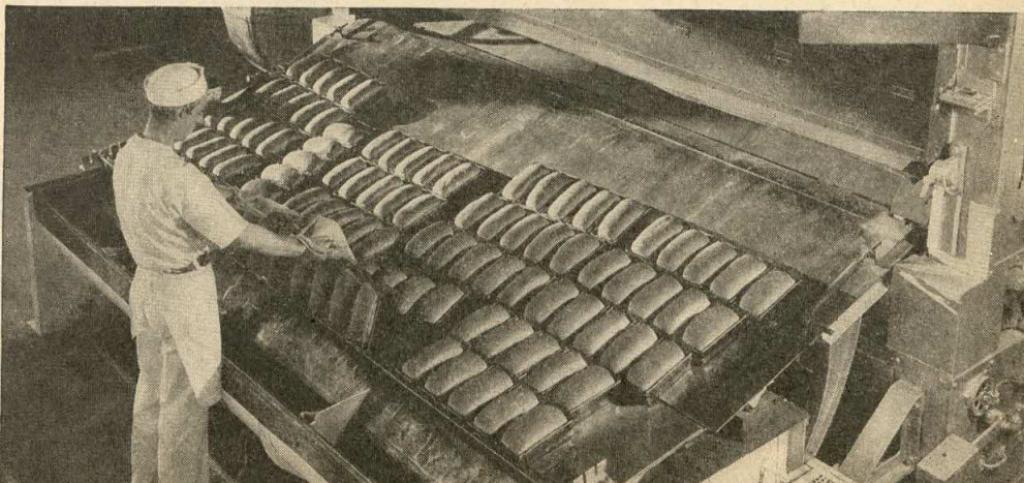
Ingredients, 3¢	Labor and overhead costs, $3\frac{1}{4}$ ¢
Margin to the grocer, $1\frac{7}{8}$ ¢	Slicing and wrapping, $\frac{1}{4}$ ¢

The remainder was profit to the bakery. What was the average profit received by the bakery on each loaf?

3. If the bakery (problem 2) sells 10,000 loaves each day, what is its daily profit?

4. If a family buys an average of $1\frac{1}{2}$ 1-pound loaves of bread each day at an average price of $9\frac{1}{2}$ ¢ a loaf, find the cost of the bread eaten by that family in 1 year (365 days).

5. The weight of a loaf of bread cannot be determined by its size. If there is a shortage in weight of 2 ounces a loaf, how many ounces are missing from the bread purchased during a year of 365 days by a family which uses 2 loaves daily?



DIAGNOSTIC TEST IN MULTIPLICATION OF FRACTIONS

Copy and multiply the following:

<i>a</i>	<i>b</i>	<i>c</i>
I. $\frac{5}{6} \times 7$	$\frac{3}{4} \times 9$	$\frac{5}{12} \times 11$
II. $\frac{3}{4} \times 14$	$\frac{7}{8} \times 30$	$\frac{9}{10} \times 25$
III. $8 \times \frac{3}{4}$	$12 \times \frac{7}{8}$	$6 \times \frac{7}{8}$
IV. $4\frac{1}{2} \times 9$	$2\frac{3}{4} \times 14$	$5\frac{1}{6} \times 15$
V. $\frac{3}{4} \times \frac{7}{8}$	$\frac{5}{8} \times \frac{3}{16}$	$\frac{4}{9} \times \frac{5}{7}$
VI. $\frac{5}{6} \times \frac{8}{9}$	$\frac{3}{4} \times 7\frac{2}{3}$	$4\frac{5}{6} \times \frac{9}{10}$
VII. $9\frac{1}{4} \times 6\frac{1}{2}$	$4\frac{1}{5} \times 3\frac{1}{7}$	$2\frac{1}{2} \times 6\frac{2}{3}$
VIII. $2 \times 1\frac{1}{4} \times 3\frac{1}{2}$	$4\frac{2}{3} \times 2\frac{5}{6} \times 3$	$6\frac{1}{4} \times 3\frac{1}{2} \times 4$

If you missed more than one example in any group, turn to pages 303-304 for practice exercises keyed to this test.

FINDING ERRORS IN MULTIPLICATION

1. Copy and solve the following examples. Compare your work with that given and find the error in each example.

a. $\frac{3}{4} \times \frac{4}{3} = 0$

b. $\frac{5}{6} \times \frac{7}{10} = \frac{7}{2} = 3\frac{1}{2}$

c. $8\frac{1}{4} \times 3\frac{1}{3} = \frac{33}{4} \times \frac{10}{3} = \frac{110}{4} = 25$

d. $4\frac{1}{2} \times 6 \times 1\frac{1}{4} = \frac{9}{2} \times \frac{6}{2} \times \frac{5}{4} = \frac{15}{16}$

*2. From your study of the errors in the previous examples, state why all examples in multiplication of fractions should be written in the following form:

$$\frac{3}{4} \times \frac{7}{9} = \frac{3 \times 7}{4 \times 9}$$



THE COST OF STEAK

A group of people who operate restaurants recently had a demonstration showing the cost of highest-grade steak. This steak is taken from that part of the beef which is called the **loin**. The loin from half a beef was cut into the different parts that could be sold. The weight of each part and the retail price a pound is given in the table:

a.	$5\frac{1}{4}$ lb. fat	at 3¢ lb.	d.	$2\frac{1}{4}$ lb. waste	at 4¢ lb.
b.	$6\frac{1}{2}$ lb. bones . . .	" 2¢ "	e.	$4\frac{1}{4}$ lb. tenderloin . . .	90¢ "
c.	$9\frac{1}{2}$ lb. flank	" 9¢ "	f.	$11\frac{1}{2}$ lb. sirloin	" 72¢ "

1. Find the total weight of the loin of half a beef.
2. Find the cost of each part of the loin.
3. What is the total cost of the entire half of the loin?
4. What is the average cost a pound of the loin of beef?
5. The waste, fat, and bones represent what part of the entire loin?
6. If there was the same amount of loin in each half of this beef, how much loin was in the beef?
7. The average serving of a sirloin steak weighs 14 ounces. Find the cost of a steak of this size at 72¢ a pound.
8. What would be the cost of a tenderloin steak weighing 14 ounces at 90¢ a pound?

DIAGNOSTIC TEST IN DIVISION OF FRACTIONS

In division of fractions, be sure to invert the divisor.
Copy and divide the following:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
I.	$\frac{3}{4} \div 2$	$\frac{7}{8} \div 3$	$\frac{3}{5} \div 2$	$\frac{9}{10} \div 4$
II.	$\frac{4}{5} \div 2$	$\frac{6}{7} \div 4$	$\frac{8}{9} \div 6$	$\frac{15}{16} \div 3$
III.	$8 \div \frac{2}{3}$	$12 \div \frac{3}{4}$	$34 \div \frac{4}{9}$	$69 \div \frac{6}{7}$
IV.	$\frac{2}{3} \div \frac{3}{4}$	$\frac{7}{8} \div \frac{5}{9}$	$\frac{4}{5} \div \frac{3}{8}$	$\frac{5}{6} \div \frac{4}{7}$
V.	$4 \div 5\frac{1}{5}$	$3 \div 1\frac{1}{2}$	$5 \div 1\frac{1}{4}$	$4 \div 6\frac{2}{3}$
VI.	$2\frac{1}{2} \div 3\frac{1}{4}$	$6\frac{2}{3} \div 4\frac{5}{6}$	$4\frac{1}{2} \div 6\frac{1}{4}$	$8\frac{1}{3} \div 4\frac{5}{9}$
VII.	$1 \div 2$	$8 \div 9$	$15 \div 18$	$36 \div 48$

If you missed more than one example in any group, turn to pages 304-305 for practice exercises keyed to this test.

FINDING ERRORS IN DIVISION

1. Copy and solve the division examples below. Compare your work with that given and find the error in each example.

a. $\frac{3}{4} \div \frac{2}{3} = \frac{3}{4} \times \frac{2}{3} = \frac{\cancel{3} \times \cancel{2}}{\cancel{4} \times \cancel{3}} = \frac{1}{2}$

b. $\frac{5}{6} \div \frac{3}{8} = \frac{6}{5} \times \frac{3}{8} = \frac{-6 \times 3}{5 \times -8} = \frac{9}{20}$

c. $2\frac{1}{4} \div 3 = \frac{9}{4} \div 3 = \frac{9 \times 3}{4} = \frac{27}{4} = 6\frac{3}{4}$

*2. Clifford knew that $4 \div \frac{2}{3} = 6$; but he did not understand why the result should be greater than 4, the number divided. State why it is greater.

PLANNING A CLASS PARTY

Some girls of the Kent School decided to bake cakes for a class party. They used the following recipe:

$\frac{1}{2}$ cup butter	2 squares chocolate
1 cup sugar	2 eggs
1 $\frac{1}{2}$ cup cake flour	1 tsp. vanilla
$\frac{1}{2}$ cup milk	1 tsp. baking powder

The recipe made a cake 9 inches in diameter.

1. By measurement with a string, the circumference (distance around) of the cake was found to be about 28 inches. Tell why this was correct.
2. If each cake was to serve ten people, how many cakes were required for a group of 60 pupils?
3. One cup of butter weighs about $\frac{1}{2}$ pound. Find the cost of the butter at 32¢ a pound.
4. One cup of sugar weighs about $\frac{1}{2}$ pound. Find the cost of the sugar at 6¢ a pound.
5. Find the cost of the milk at 8¢ a pint (2 cups = 1 pt.).
6. If the eggs cost 30¢ a dozen, find the cost of the eggs used in the cakes.
7. The girls bought a package of cake flour containing 2 pounds 12 ounces for 33¢. If a cup of flour weighs $\frac{1}{4}$ pound, how much flour was left over?
8. The chocolate and vanilla cost 50¢. Find the total cost of making the cakes.
- *9. How much would it cost you to make one of the cakes?



DIAGNOSTIC TEST IN ADDITION OF DECIMALS

Do not copy the examples. Write the sums on a folded paper placed below the examples.

	<i>a</i>	<i>b</i>	<i>c</i>		<i>a</i>	<i>b</i>	<i>c</i>
I.	.6	.3	.9	III.	4.3	5.6	3.8
	.8	.5	.4		8.8	1.9	0.4
	.9	.7	.8		1.9	0.5	0.7
	<u> </u>	<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>
II.	.07	.45	.60	IV.	5.35	7.46	.050
	.04	.78	.30		0.46	3.85	.750
	.05	.96	.50		1.90	0.96	.450
	<u> </u>	<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>

If you missed more than one example in any group, turn to page 305 for practice exercises keyed to this test.

DIAGNOSTIC TEST IN SUBTRACTION OF DECIMALS

Copy and subtract the following:

	<i>a</i>	<i>b</i>	<i>c</i>		<i>a</i>	<i>b</i>	<i>c</i>
I.	.85	.40	.60	III.	6.00	5.80	3.50
	.25	<u>.25</u>	.38		<u>1.47</u>	<u>1.56</u>	<u>0.95</u>
	<u> </u>	<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>
II.	9.6	5.5	7.5	IV.	6.75	1.00	1.315
	2.6	<u>3.8</u>	<u>4.5</u>		<u>6.70</u>	<u>0.93</u>	<u>1.307</u>
	<u> </u>	<u> </u>	<u> </u>		<u> </u>	<u> </u>	<u> </u>

If you missed more than one example in any group, turn to page 306 for practice examples keyed to this test.

QUESTIONS TO ANSWER

1. Jim said, "Adding and subtracting decimals is like adding and subtracting whole numbers except that the decimal point is written in the result." Why was he correct? Where is the point always written in the result?

*2. Harry saw the following puzzle problem: .4 + .044 + 4 + .0044 + 40. Find the sum of these numbers.

PLACING THE POINT IN THE PRODUCT

Copy each product and place the decimal point in the correct position, inserting zeros if necessary.

1.	4.5	2.	.96	3.	.04	4.	.54	5.	.48	6.	.81
	7		1		2		.5		.4		.2
	315		96		8		270		192		162
7.	.08	8.	1.4	9.	.25	10.	.1	11.	523	12.	.83
	.08		1.4		.25		.1		.01		70
	64		196		625		1		523		5810
13.	1.1	14.	58	15.	.02	16.	.67	17.	9.8	18.	.33
	.1		.001		.2		.05		1.5		.003
	11		58		4		335		1470		99

19. Multiply each of the following numbers by 10, 100, and 1000: *a.* .76; *b.* .035; *c.* 8.4; *d.* 63.7; *e.* .0001.

20. Complete the statements: To multiply a decimal by 10, move the point (?); to multiply by 100, move the point (?); to multiply by 1000, move the point (?).

DIAGNOSTIC TEST IN MULTIPLICATION OF DECIMALS

Copy and multiply the following:

	<i>a</i>	<i>b</i>	<i>c</i>		<i>a</i>	<i>b</i>	<i>c</i>	
I.	.45	.38	4.8		IV.	7.5	3.47	46.5
	3	6	6			1.5	1.5	3.8
II.	.07	.01	3.05		V.	.83	7.06	.025
	6	5	2			.06	.04	.03
III.	65	620	875		VI.	7.65	83.4	72.549
	.6	.4	.02			10	100	1000

If you missed more than one example in any group, turn to pages 306-307 for practice exercises keyed to this test.

STUDY HELPS IN DIVISION OF DECIMALS

1. Bill had a piece of wire 8.6 feet long which he cut into two equal pieces. What was the length of each piece?

$$\begin{array}{r} 4.3 \\ 2)8.6 \end{array}$$
 Is the decimal point in the quotient placed correctly or incorrectly? Why?
The length of each piece was 4.3 feet.

2. How many pieces of ribbon, each of which is 1.5 yards long, can be cut from a piece 6 yards long?

$$\begin{array}{r} 4 \\ 1.5)6 = 15)60 \\ \underline{60} \end{array}$$
 To change the divisor to a whole number, multiply both the divisor and the number divided by 10.

3. How many dresses requiring 2.5 yards of cloth each may be made from 7.5 yards?

$$\begin{array}{r} 3 \\ 2.5)7.5 = 25)75 \\ \underline{75} \end{array}$$
 How were 2.5 and 7.5 changed?

4. What is the smallest number each of the following numbers may be multiplied by to make it a whole number:

a. 4 6? b. 52? c. 3.68? d. 1.755? e. .625? f. .7? g. 1.25?

5. Copy, and place the point correctly in the quotient:

a. $4\overline{)8.4}$

b. $6\overline{).72}$

c. $5\overline{).95}$

d. $.2\overline{)4}$

e. $.1\overline{)10}$

f. $.3\overline{)6.9}$

g. $.45\overline{)90}$

h. $1.2\overline{)8.4}$

i. $.36\overline{)14.4}$

j. $.56\overline{)560}$

k. $.01\overline{)1}$

l. $2.4\overline{)9.6}$

6. Divide .16 by 8.

The zero is placed in the quotient before the
.02 2 to indicate that there are no tenths in the
8).16 result. How can you check the result to prove
that it is correct?

7. Copy each example and place the point correctly in
the quotient.

$$a. \underline{4)12}$$

$$b. \underline{7)217}$$

$$c. \underline{9)369}$$

$$d. \underline{14)084}$$

$$e. \underline{7.6)228}$$

$$f. \underline{98)0392}$$

$$g. \underline{5.4)0108}$$

$$h. \underline{26)0676}$$

8. Divide the following and check the result by multi-
plication:

$$a. \underline{3)15}$$

$$b. \underline{5)125}$$

$$c. \underline{.5)125}$$

$$d. \underline{6)012}$$

$$e. \underline{.004)8.}$$

$$f. \underline{5.1)306}$$

$$g. \underline{.01)1}$$

$$h. \underline{4.03)523.9}$$

9. The following examples have the decimal point placed
correctly in the quotient. Tell how the position of the
point was found.

$$a. \underline{.6)48}$$

$$b. \underline{4)1}$$

$$c. \underline{25)7.75}$$

$$d. \underline{28)14}$$

$$e. \underline{2.5)5}$$

$$f. \underline{1.6)264}$$

$$g. \underline{3.6)9.36}$$

$$h. \underline{.04)172}$$

$$i. \underline{3.2)672}$$

$$j. \underline{6.5)1625}$$

$$k. \underline{6.8)34}$$

$$l. \underline{12)9}$$

WAYS OF EXPRESSING A NUMBER

You know that 1 is equal to 10 tenths, 100 hundredths, or 1000 thousandths. Then 1 may be written as 1.0, 1.00, or 1.000.

1. There are how many tenths in 5? in 4.5? in 12? in 12.8? in .6? in .65? in .70?
2. There are how many hundredths in 4? in 4.2? in .3? in .16? in 1.25? in .325?
3. There are how many thousandths in 6? in 6.2? in .75? in 1.05? in .225? in .05?
4. There are how many ones in 30 tenths? in 45 tenths? in 500 hundredths? in 750 hundredths? in 9000 thousandths?
5. Give the number of tenths, hundredths, and thousandths in each of the following:

a. 4	c. .3	e. .75	g. 7	i. .08
b. 1.9	d. 10.5	f. .05	h. 7.7	j. 3.2

CHANGING A COMMON FRACTION TO A DECIMAL

1. Change the fraction $\frac{5}{8}$ to a decimal.

$$\begin{array}{r} .625 \\ \frac{5}{8} = 8)5.000 \\ \underline{48} \\ 20 \\ \underline{16} \\ 40 \\ \underline{40} \\ 0 \end{array}$$

In 5 there are 50 tenths, 500 hundredths, and 5000 thousandths. Since neither the tenths nor the hundredths can be divided evenly by 8, the 5 is changed to 5000 thousandths which can be divided evenly by 8.

2. Change the following to decimals: a. $\frac{3}{4}$; b. $\frac{1}{8}$; c. $\frac{1}{4}$; d. $\frac{5}{16}$; e. $\frac{6}{25}$; f. $\frac{4}{5}$; g. $\frac{7}{8}$; h. $\frac{9}{20}$; i. $\frac{17}{25}$; j. $\frac{3}{20}$.
3. Change $\frac{1}{3}$ to a three-place decimal. Can the exact decimal value be found for $\frac{1}{3}$? for $\frac{1}{6}$? for $\frac{5}{12}$? for $\frac{9}{16}$?

DIAGNOSTIC TEST IN DIVISION OF DECIMALS

Copy and divide the following:

a b c

I. $4\overline{)7.2}$ $3\overline{)5.7}$ $7\overline{)8.4}$

a b c

V. $.3\overline{)7.2}$ $.6\overline{)4.8}$ $.7\overline{)4.55}$

II. $2\overline{).12}$ $3\overline{).18}$ $6\overline{).54}$

VI. $25\overline{).05}$ $36\overline{).018}$ $12\overline{).03}$

III. $.6\overline{)18}$ $.4\overline{)6}$ $.3\overline{)45}$

VII. $2\overline{)1}$ $25\overline{)12}$ $8\overline{)3}$

IV. $.05\overline{)18}$ $.15\overline{)75}$ $.24\overline{)96}$ VIII. $.1.7\overline{).391}$ $.24\overline{).768}$ $1.2\overline{)3.756}$

If you missed more than one example in any group, review the study helps in division of decimals (pages 22-23). After you understand these study helps, turn to pages 307-308 for practice exercises keyed to this test.

*TOPICS FOR SPECIAL REPORTS

1. Write a brief history of the development of the metric system.
2. What is the purpose of the United States Bureau of Standards?
3. Our number system is called the "Hindu-Arabic System." Show why it is called by this name.
4. The chief characteristic of our number system is place value. What does place value mean? Illustrate it. Show that the Roman system of number does or does not have place value.
5. Bring one or more news items to class which require some mathematics in order to understand them. State what mathematics is necessary to understand each item.

ROUNDING OFF LARGE NUMBERS

Jack saw the following news item in his morning paper, "Federal Government spends \$9,356,174,982." He remembered that large numbers are sufficiently accurate for most purposes (and certainly easier to recall), if rounded off. So he expressed the amount, correct to the nearest million, as \$9,356,000,000. That is, he replaced some of the actual figures by zeros, mere place holders in the number which he rounded off.

1. Study the following examples which show how numbers may be rounded off to the nearest thousand:

a. 5295 is rounded off to 5000 because the first figure dropped (2) is less than 5.

b. 6540 is rounded off to 7000 because the first figure dropped is 5.

c. 13,682 is rounded off to 14,000 because the first figure dropped (6) is greater than 5.

From these three examples make up a rule to use in rounding off numbers.

2. How many figures are replaced by zero when a number is rounded off to the nearest hundred? to the nearest ten thousand?

3. Round off the expenditures of the Federal Government, as given in the news item, to the nearest hundred million; to the nearest hundred thousand.

4. Round off the following to the nearest thousand:
a. 7499; b. 9500; c. 19,600; d. 850; e. 16,600.

5. Round off the following to the nearest hundred:
a. 450; b. 649; c. 7960; d. 3849; e. 1880.

*6. On the books of the Government at Washington were the actual figures for expenditures entered or were the numbers rounded off? Explain.

ROUNDING OFF A QUOTIENT

1. On a trip of 325 miles, Mr. Scott's motor truck used 21 gallons of gasoline. Find the average mileage a gallon.

$$\begin{array}{r} 15.476 \\ 21 \overline{)325.000} \end{array}$$

21

115

105

100

84

160

147

130

126

4

The exact mileage a gallon cannot be found as a decimal. But accuracy to the nearest tenth of a mile is close enough for all practical purposes.

2. What was the number of miles a gallon to the nearest tenth of a mile? to the nearest hundredth of a mile?

The statements, "Express to the nearest tenth," or "to the nearest hundredth," may be written, "Express to the nearest 0.1," or "to the nearest 0.01."

3. The following examples show that decimals may be rounded off in the same manner as whole numbers.

.473 to nearest 0.01 is .47. Why? .587 to nearest 0.01 is .59. Why? 3.95 to nearest 0.1 is 4.0. Why?

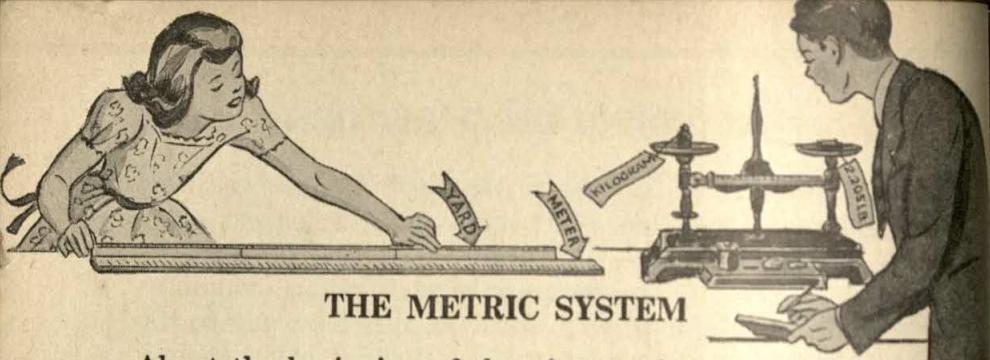
From these three examples make up a rule to use in rounding off a decimal.

4. Round off the following to the nearest 0.1: *a.* .46; *b.* .449; *c.* .95; *d.* 1.96; *e.* .329; *f.* .005.

5. Round off the following to the nearest 0.01: *a.* .536; *b.* .374; *c.* .095; *d.* 1.956; *e.* 9.995; *f.* .2449.

6. Express to the nearest 0.1 and then to the nearest 0.01: *a.* $\frac{1}{3}$; *b.* $\frac{2}{3}$; *c.* $\frac{5}{16}$; *d.* $\frac{7}{8}$; *e.* $\frac{3}{7}$; *f.* $\frac{5}{12}$.

7. A ballplayer's batting average is found by dividing the number of hits made by the number of times at bat. If a player was at bat 97 times and made 34 hits, find his batting average to the nearest 0.001.



About the beginning of the nineteenth century, France adopted a system of measures based on 10. Each higher unit is ten times the next smaller unit. The standard for this system of measurement is the **meter** (measure), the length of which is about one ten-millionth of the distance from the Equator to the North Pole. This system of measures is called the "Metric System."

Our system of measurement is called the "English System." The units of length of the two systems are shown in the following table:

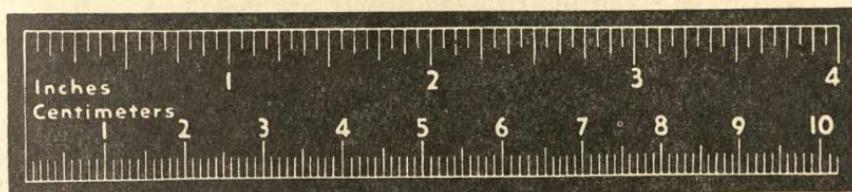
12 in.	= 1 foot	10 millimeters (mm.)	= 1 centimeter (cm.)
3 ft.	= 1 yard	10 centimeters	= 1 decimeter
5½ yd.	= 1 rod	10 decimeters	= 1 meter (m.)
320 rd.	= 1 mile	10 meters	= 1 decameter
		10 decameters	= 1 hectometer
		10 hectometers	= 1 kilometer (km.)

Note from the metric table that each succeeding unit is multiplied by 10 to find the next measure. This is not true for the English system of measures. The relation between a foot and the next higher unit is not 10, but 3, for the yard is three times the length of the foot. In other words, our system of measuring distances is not a **decimal** (based on 10) system.

1. Find the number of inches in a rod; in a mile.
2. Find the number of millimeters in a meter; the number of millimeters in a kilometer.
3. Which of the two problems did you find more difficult?

FAMILIAR UNITS IN THE METRIC SYSTEM

The meter is equivalent to 39.37 inches; that is, the meter is almost one tenth longer than the yard. From the table (page 28) you see that there are 100 centimeters in a meter. The length of a centimeter and of an inch are as shown.

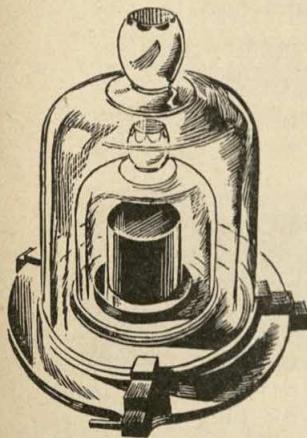


Some metric measures are used so infrequently in this country that we need not study them. The most important measures of length are the centimeter, the meter, and the kilometer. The approximate values of these measures in our system are given in the following table:

1 centimeter	= .4 in.
1 meter	= 3.3 ft.
1 kilometer	= .6 mi.

1. Professor Piccard of Belgium reached a height of 16,201 meters in his ascent into the stratosphere. How many kilometers did he ascend?
2. Captain Settle of the U. S. Navy reached a height of 61,217 feet. To the nearest hundredth, how many miles did he ascend?
3. Change 3.4 kilometers to meters; to centimeters.
4. Change 468 centimeters to meters; to kilometers.
5. Change $2\frac{1}{4}$ miles to feet; to inches.
6. Change 23,760 feet to miles.
- *7. Which is longer, the 100-yard dash or the 100-meter dash? How much longer?

METRIC SYSTEM OF WEIGHT



The unit of weight in the metric system is the **gram**. The most widely used metric measure of weight is the **kilogram**. The picture shows the kilogram which is kept at the United States Bureau of Standards at Washington.

Part of the metric table for weights follows:

$$\begin{aligned}10 \text{ grams (g)} &= 1 \text{ decagram (dg)} \\10 \text{ decagrams} &= 1 \text{ hectogram (hg)} \\10 \text{ hectograms} &= 1 \text{ kilogram (kg)}\end{aligned}$$

1. How many grams are there in a kilogram?
2. A kilogram is about 2.2046 pounds. Which of the following is approximately equal to a gram?
 - a. .22 lb.; b. .022 lb.; c. .0022 lb.; d. .00022 lb.
3. The Standard kilogram at the United States Bureau of Standards weighs 999.99998 grams. How much does it vary from a perfect standard?
4. Part of the English system of measures of weight is as follows:

$$\begin{aligned}16 \text{ ounces (oz.)} &= 1 \text{ pound (lb.)} \\100 \text{ pounds} &= 1 \text{ hundredweight (cwt.)}\end{aligned}$$

Is there uniformity in the steps in the English measures of weight as there is in the metric system? Explain.

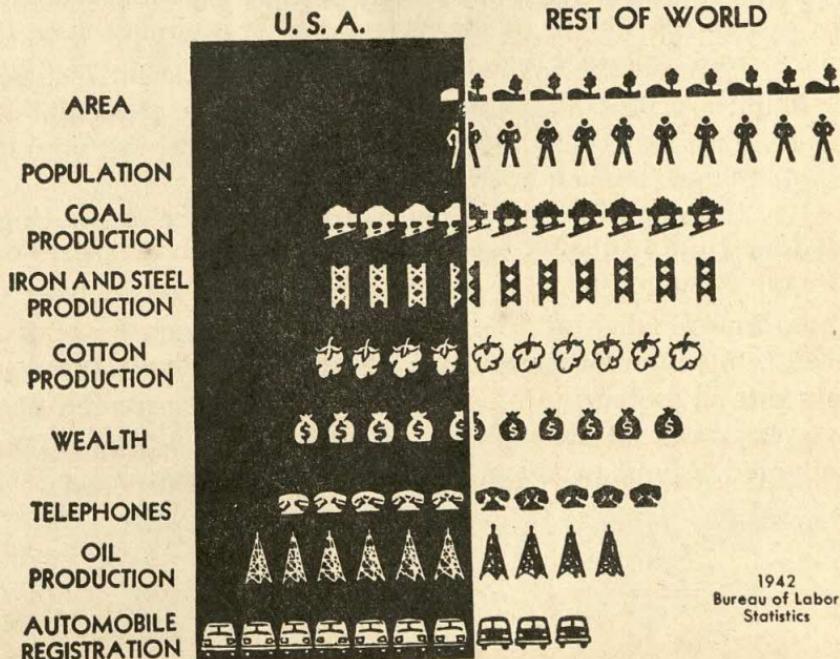
- *5. The English system of measures has been described as a **collection** of measures and the metric system as a **system** of measures. What is meant by this statement?
- *6. From problem 3 is the error in the measurement of the kilogram more or less than 1 part in 10,000 parts?

THE UNITED STATES AND THE WORLD

1. How many symbols are used to represent each of the nine items shown on the graph? Each whole symbol represents what per cent of the total?
2. The land area of this country is about 5% of the total land area in the world. What per cent of the land area in the world is outside this country?
3. About what per cent of the population of the world lives in the United States?
4. The United States produces at least 50% of how many of the commodities shown?

*5. a. The wealth of this country is what per cent of the wealth of the world?
b. If our wealth were proportionate to our land area, what percentage of the world's wealth would we have?
c. Our wealth is about how many times as great as it would be according to land area?

31





HOW WELL DO YOU REMEMBER?



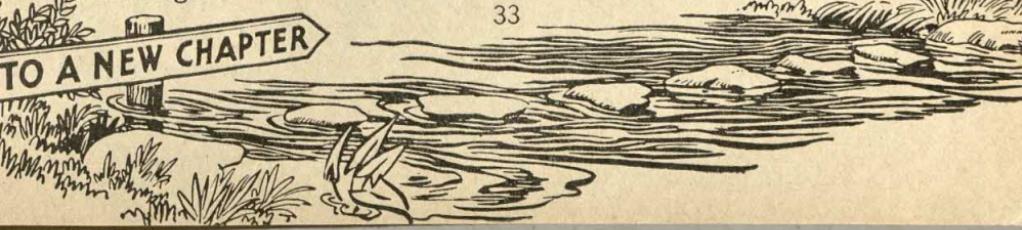
1. There are how many hundreds, tens, and ones in each of the following:
 - a. 74,300? b. 600,000? c. 1,000,000? d. 148,000?
2. There are how many thousands in a million?
3. There are how many thousandths in .006? in .05?
4. Arrange the following decimals in order of size, beginning with the smallest: .5; .04; .1; .009; .06.
5. Moving the decimal point one place to the right is the same as multiplying by (?); moving it two places to the right is the same as multiplying by (?).
6. What is the smallest number each of the following numbers must be multiplied by to make it a whole number: a. 3.14? b. .765? c. 1.43? d. .075? e. 3.255?
7. What is the smallest common denominator for fractions having denominators: a. of 2, 6, and 8? b. of 3, 6, 8, and 12?
8. Write decimal fractions which have the same value as the following common fractions: a. $\frac{1}{4}$; b. $\frac{1}{8}$; c. $\frac{2}{5}$; d. $\frac{5}{8}$; e. $\frac{3}{4}$; f. $\frac{3}{5}$; g. $\frac{5}{16}$.
9. Express the following to the nearest tenth: a. 6.34; b. 4.09; c. 8.95; d. 0.99; e. 7.04.
10. Express the following to the nearest thousand: a. 46,300; b. 53,500; c. 97,499; d. 99,900.
11. Name three units for measuring distance in the English system; in the metric system.
12. Which is longer, a yard or a meter? an inch or a centimeter?
13. A plane averages 310 kilometers an hour. What is its rate in meters?
14. About 90 per cent of the automobiles stolen are recovered. About what per cent are not recovered?

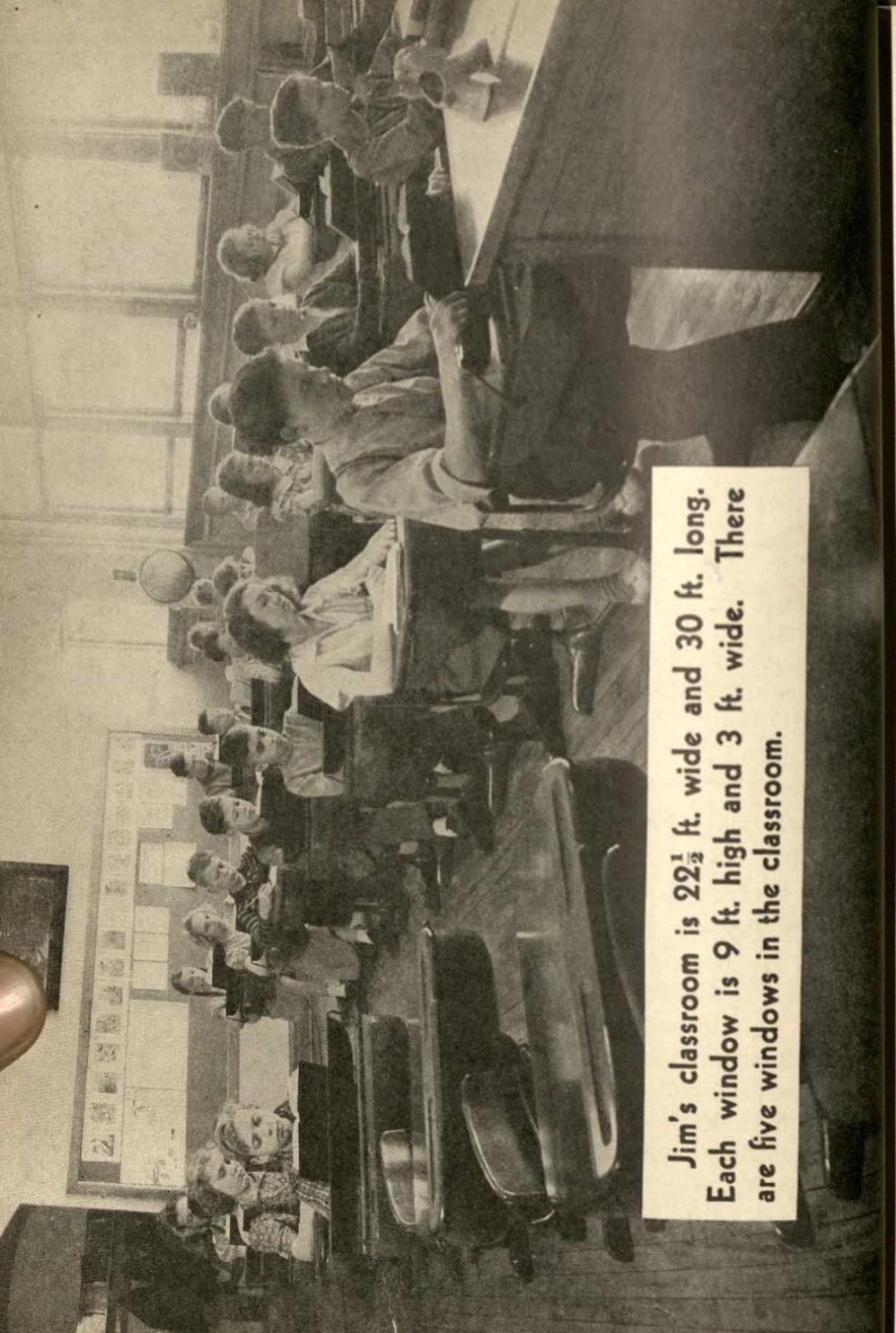
THINGS TO REMEMBER

1. How to add, subtract, multiply, and divide with whole numbers, fractions, and decimals.
2. How to round off numbers.
3. The meaning of the metric system and some of its most widely used units of measurement.
4. How mathematics helps you to understand some of the things which you read in the news.

TEST ON CHAPTER I

1. A news headline stated that the Federal Government had just appropriated more than ten billion dollars. What mathematical term was used in this headline?
2. How many millions are there in ten billion? Write ten billion with figures.
3. Multiply 806 by 704 and check the result by two different methods.
4. When multiplication is used to check an example in division in which there is a remainder, how is the remainder used in the check? Divide 9367 by 18 and check the solution by multiplication.
5. Round off the following to the nearest hundredth:
a. 6.382; *b.* 0.076; *c.* 0.095; *d.* 2.004; *e.* 0.395.
6. How do you change feet to miles? Change 18,480 feet to miles.
7. How do you change meters to kilometers? Change 18,480 meters to kilometers.
8. A kilometer is equal to about $\frac{5}{8}$ of a mile. If an airplane has a speed of 360 kilometers an hour, what is its speed in miles an hour?
9. What is the lowest common denominator for fractions having denominators of 3, 4, and 6?





Jim's classroom is $22\frac{1}{2}$ ft. wide and 30 ft. long. Each window is 9 ft. high and 3 ft. wide. There are five windows in the classroom.

CHAPTER II

MORE ABOUT THE FORMULA

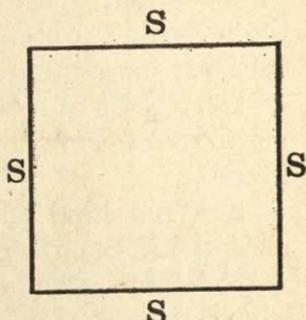
1. What kind of geometric figure is this?
2. How long is each of its sides?
3. What is the distance around the square?
4. How did you find this distance (problem 3)? What do you call this distance?
5. Write the rule for finding the perimeter of a square.
6. Write the formula for finding the perimeter of a square.
7. In the formula what did you use in place of numbers?
A formula, as you remember, is simply a short way of expressing a rule by using letters in place of numbers or words.
8. If the distance to a camp is 60 miles and you drive there in 2 hours, what is your speed an hour?

RULE: Speed is distance divided by time.

$$\text{FORMULA: } S = \frac{D}{T}$$

Tell what each letter in the formula means.

9. Find the perimeter of a square having a side of:
a. 6 in.; *b.* 2 ft.; *c.* $5\frac{1}{4}$ ft.; *d.* 7.4 yd.; *e.* 18 cm.
10. If the side of one square is $6\frac{1}{2}$ feet and the side of another square is $5\frac{3}{4}$ feet, what is the difference in their perimeters?
- *11. Write formulas to represent 4 rules in arithmetic that you have learned.



SIGHT SAVING

One day a lecturer came to Jim's school. The lecturer talked about "Sight Saving." "The windows of a classroom," said the lecturer, "should not be less than one fifth the floor area." Jim remembered that statement.

1. Page 34 is a picture of Jim's classroom. *a.* How wide is the room? How long? *b.* How wide is each window? How high?
2. What kind of geometric figure is the floor of Jim's classroom? Each window?
3. What is the area of the floor of Jim's classroom? Of each window?
4. How did you find the area of the floor? Of the window?
5. Find the area of each of the following rectangles
(HINT: $A = lw$). What does "*l*" mean? "*w*"?

<i>l</i>	<i>w</i>	<i>l</i>	<i>w</i>
<i>a.</i> 4 in.	3 in.	<i>d.</i> 4 mi.	3 mi.
<i>b.</i> 4 ft.	3 ft.	<i>e.</i> 4 cm.	3 cm.
<i>c.</i> 4 yd.	3 yd.	<i>f.</i> 4 km.	3 km.

6. Write the rule for finding the area of a rectangle.
7. Write the formula for finding the area of a rectangle.
8. What is the difference, if any, between lw and $l \times w$?
9. In finding the area of a rectangle, length and width must be expressed by the same unit of length (**linear unit**). What is the unit of length in problem 5*a*? 5*b*? 5*c*? 5*d*?
10. Why can you not find the area of the following rectangle by using the dimensions as given? $l = 4$ ft., $w = 3$ yd.
- *11. Jim's classroom has 5 windows. How much more than one fifth the floor area is the window area?

THE AREA OF RECTANGLES

Find the area of rectangles whose dimensions are:

LENGTH	WIDTH	LENGTH	WIDTH
1. 15 in.	9 in.	8. 21 ft.	16 ft.
2. 27 ft.	18 ft.	9. 14 yd.	8 yd.
3. 8 mi.	3 mi.	10. $6\frac{1}{2}$ ft.	4 ft.
4. 18 in.	$9\frac{7}{8}$ in.	11. $4\frac{2}{3}$ yd.	$2\frac{1}{2}$ yd.
5. $1\frac{1}{4}$ mi.	$\frac{3}{4}$ mi.	12. 25.5 in.	16.4 in.
6. 7.8 ft.	3.6 ft.	13. 47.2 ft.	12.5 ft.
7. 46 cm.	28 cm.	14. 76 cm.	38 cm.

15. A window has 8 panes, 18 inches by 14 inches. What is the area of each pane? of the window? (The space between each pane need not be considered.)

16. The dimensions of two rugs are $9' \times 12'$ (9 ft. by 12 ft.) and $8\frac{1}{2}' \times 11\frac{1}{2}'$. Find the difference in their areas.

17. The floor of a living room is $13' \times 20'$. If a rug, $12' \times 16\frac{1}{2}'$ is on the floor, how much of the floor is not covered?

18. The floor area for basketball is not uniform. The official playing court of greatest area is 94 feet long and 50 feet wide; the official playing court of smallest area is 60 feet long and 35 feet wide. How much greater is the area of one playing court than the other?

*19. If the length of a rectangle is doubled, but its width remains unchanged, how does that affect its area?

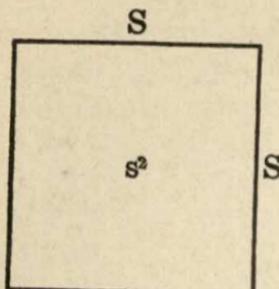
*20. If the width of a rectangle is doubled, but its length remains unchanged, how does that affect its area?

*21. If both the length and width of a rectangle are doubled, how does that affect its area?

*22. If the length of a rectangle is doubled, and its width is halved, how does that affect its area?

*23. Find how much more or less the window area of your classroom is than one-fifth the floor space.

MORE ABOUT THE AREA OF A SQUARE



1. Choose the correct answer, "Yes" or "No":
 - a. Are the sides of this figure of equal length?
 - b. Are the corners square?
 - c. Is the figure a square?
 - d. Is it a rectangle?
 - e. Are all squares rectangles?
 - f. Are all rectangles squares?
2. a. Write the formula for the area of a rectangle.
b. Are " l " and " w " of equal length in a square, or different?
c. Change the formula for the area of a rectangle to a formula for the area of a square, side " l "; side " w ".
3. a. How are the sides of the square on this page labeled? the area?
b. Read this formula: $s \times s = s^2$.
c. What is the value of s^2 if $s = 2? 4? 6? 8? 10?$
- Find the areas of squares having sides:
4. 8 in. 6. 12 ft. 8. $6\frac{1}{4}$ ft. 10. 4.6 ft.
5. $3\frac{1}{2}$ yd. 7. 1 mi. 9. 20 cm. 11. 4.5 m.
12. Find the perimeters in examples 6, 7, 8, and 9.
13. A square has a side of 3 inches and another square has a side twice as long. What is the perimeter of each figure? the area of each?
- *14. If the side of a square is doubled, how does that affect its perimeter? its area?
- *15. Clifford said, "Doubling the side of a square has the same effect on its area as doubling both the length and width of a rectangle." Prove that he was correct.

40 RODS



AN ACRE

Land is measured by the **acre**. Long ago, in England, an acre was simply the amount of land two oxen, yoked together, could plow in a day.

1. What is the shape of the plowed strip? How long? How wide? Its area? Is the plowed land an acre, more, or less?
2. Here are two geometric forms. Name them. What is the area of each form? May an acre be any shape? Explain.
3. a. How many feet are in a rod?
b. How many square feet are in an acre?
- *4. Prove that there are 640 acres in a square mile.
- *5. What is a section of land?

160
Sq. Rd.

160
Sq. Rd.

1

LET'S PRACTICE



1. $864 + 509 + 476 + 592 + 870 + 359 = ?$
2. $4\frac{3}{8} + 5\frac{1}{4} + 12\frac{1}{2} + 9\frac{3}{4} + 1\frac{7}{8} = ?$
3. $.74 + .38 + .09 + .98 + .50 + .86 = ?$
4. $8\frac{1}{2} - 5\frac{3}{4} = ?$
5. $3\frac{1}{4} \times 6\frac{1}{2} = ?$
6. $1\frac{1}{2} \div 2 = ?$
7. $501 - 105 = ?$
8. $17 \overline{) 9182}$
9. $1\frac{1}{8} \times \frac{8}{9} = ?$
10. $14 \overline{) 19.6}$
11. $80.10 - 4.16 = ?$
12. $9\frac{1}{4} - 3\frac{5}{6} = ?$
13. $.28 \overline{) 476}$
14. $.06 \times 5.94 = ?$
15. $72 \div \frac{4}{9} = ?$
16. $1.9 \times .037 = ?$

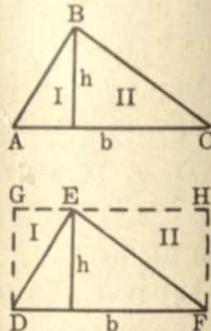
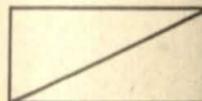


MILTON'S SAILBOAT

Milton had a sailboat. He knew, in general, that the bigger the sail the more speed the boat. So he had a natural interest in the size of his sail. What shape is the sail? How do you find its area?

A rectangle, Milton knew, can be divided by its diagonal into two equal right triangles. "But," asked Milton, "is any triangle, which has the same base and height as a rectangle, equal to half of the rectangle?"

Milton drew the triangle ABC with a base b and an altitude h . Then he drew another triangle DEF , equal to the triangle ABC . He cut the first triangle into two parts along the altitude h . He took Part I of the triangle ABC and placed it in the position of the triangle, DGE ; Part II, and placed it in the position of the triangle, FEH . What kind of a figure did he form?



1. What is the base of the figure $DFHG$? the height?
2. What is the base of the triangle DEF ? the altitude?
3. What is the area of the rectangle $DFHG$? of the triangle DEF ?
4. State the rule which Milton must use to find the area of his sail (HINT: Half the product of base and altitude).
5. Express this rule as a formula.
6. If Milton's sail is 10 feet wide at the base and 20 feet high, what is its area?

AREAS OF TRIANGLES

Find the area of triangles the dimensions of which are as follows:

BASE	ALTITUDE	BASE	ALTITUDE
1. 12 in.	8 in.	7. 14 ft.	9 ft.
2. 8 in.	6 in.	8. 26 cm.	14 cm.
3. 14 yd.	5 yd.	9. $8\frac{1}{4}$ in.	6 in.
4. 18 ft.	$7\frac{1}{2}$ ft.	10. 7 ft.	9.2 ft.
5. 12.4 ft.	8 ft.	11. 1.5 mi.	1.8 mi.
6. 1 mi.	$\frac{1}{2}$ mi.	12. $\frac{1}{2}$ ft.	2 ft.

13. If a triangular sail is 16 feet wide at the base and 9 feet high, what is its area?

*14. If two triangles have equal bases but different altitudes, which has the greater area?

*15. If two triangles have equal altitudes but different bases, which has the greater area?

*16. Draw figures to represent the triangles in problems 14 and 15.

*17. By substituting numbers for letters in the formula $A = \frac{1}{2}bh$, show that the following statements are true:
a. the area is equal to the product of the base and half of the altitude; b. the area is equal to the product of the altitude and half of the base.

*18. If the base of a triangle is doubled but its altitude remains the same, what effect does this have on its area?

*19. If the altitude of a triangle is doubled but its base remains the same, what effect does this have on its area?

*20. If both the base and the altitude of a triangle are doubled, what effect does this have on its area?

KINDS OF TRIANGLES AS TO SIDES

1. Here are 3 triangles. Which triangle has all sides of equal length? All sides unequal? Only two sides equal?

2. What is an **equilateral** triangle?

3. What is a **scalene** triangle?

4. What is an **isosceles** triangle?

5. What is the altitude of each triangle shown? its base? its area?

6. An equilateral triangle, as you see, is also **equiangular** (all angles the same size). How many degrees in each of these angles? (HINT: There are 180° in the sum of the angles of a triangle.)

7. If the side of an equilateral triangle is s , make a formula for the perimeter of the triangle.

8. Using the formula (problem 7), find the perimeter when $s = 4$ inches; when $s = 6\frac{1}{2}$ feet.

9. The base of an isosceles triangle is 5 inches and one of the equal sides is 8 inches. What is the perimeter?

10. The base of an isosceles triangle is b and one of the equal sides is s . Make a formula for the perimeter.

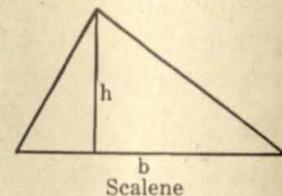
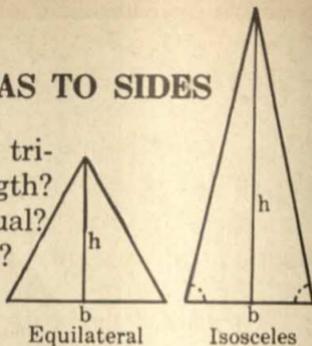
11. The sides of a scalene triangle are a , b , and c . Make a formula for the perimeter.

12. Using the formula (problem 11), find the perimeter when $a = 9$, $b = 10\frac{1}{2}$, and $c = 13\frac{3}{4}$.

*13. If an isosceles triangle contains a right angle, it is called an **isosceles right triangle**. Draw this kind of a triangle.

*14. Find the perimeter of the triangle which you have drawn.

*15. Find its area.



KINDS OF TRIANGLES AS TO ANGLES

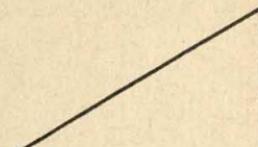
1. Here are some questions to answer and things to do:

a. How many degrees in a right angle? Draw a right angle.

b. Is an acute angle more or less than a right angle? Draw an acute angle.

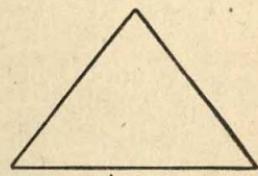
c. Is an obtuse angle more or less than a right angle? Draw an obtuse angle.

d. How many right angles in a straight angle? Draw a straight angle.



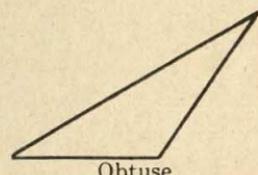
Right

2. Which of the triangles contains a right angle? This form is a **right triangle** because it contains an angle of 90° .



Acute

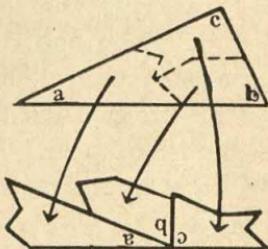
3. Which triangle contains 3 acute angles? This form is an **acute triangle** because it contains 3 angles each less than 90° .



Obtuse

4. Which triangle contains an **obtuse** angle? This form is an **obtuse triangle** because it contains an angle greater than 90° but less than 180° .

5. Draw any triangle, and label the angles. Cut angle a from the triangle and place it as shown. Do the same with angles b and c . Angles a , b , c together form what kind of an angle? Equal how many degrees?



6. The sum of the angles in any triangle equal how many degrees? Prove your answer by drawing, labeling, and cutting several triangles.

7. The number of degrees in the angles of a triangle is equal to how many right angles?

MORE ABOUT PARALLELOGRAMS

40 Rd.

1. The field (Fig. A) is how long? How far across?

2. Find two parallel sides of this field; two other parallel sides. What kind of geometric form is Figure A? What is its altitude?

3. Tell why Figure A is or is not a rectangle.

Last school year you learned one way of finding the area of a parallelogram. Doris uses another method.

She drew the parallelogram $ABCD$, and the diagonal AC . She cut along the diagonal AC and formed two triangles ABC and ADC . By placing one triangle upon the other she found that they were equal.

Doris said, "The area of the parallelogram must be twice the area of each triangle." Why was she correct?

She wrote the formula for the area of a triangle: $A = \frac{1}{2} BH$. Then she doubled this to get the formula for the area of her parallelogram. You write this formula.

4. Cut a parallelogram along its diagonal. Place one triangle upon the other. Are they equal?

5. Cut from paper two equal triangles and place them opposite each other as shown. What geometric form did you make?

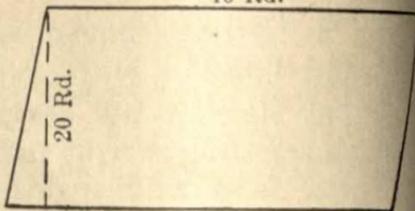


Fig. A

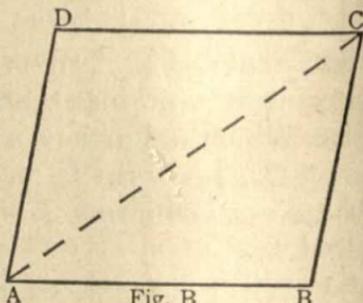
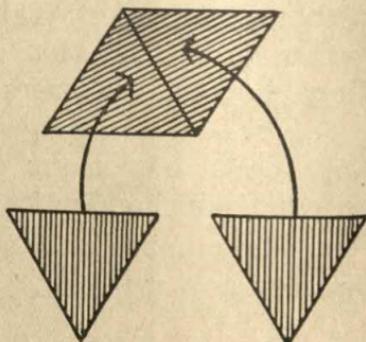


Fig. B



6. From your experiments prove that the area of a parallelogram is equal to the product of the base and the altitude.

7. Change this rule to a formula for the area of a parallelogram.

Find the area of parallelograms whose dimensions are:

BASE

ALTITUDE

8. 9 in.

6 in.

BASE

ALTITUDE

11. $6\frac{1}{2}$ ft.

14 ft.

9. $15\frac{1}{2}$ ft.

$4\frac{1}{2}$ ft.

12. $4\frac{2}{3}$ yd.

$9\frac{1}{3}$ yd.

10. 16.7 ft.

12.5 ft.

13. 14.6 cm.

9.5 cm.

14. Find the area of the field (Fig. 44-A).

*15. Find illustrations around your home or school of parallelograms which are not rectangles.

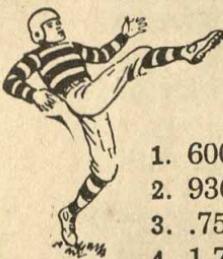
*16. Show by a drawing that a parallelogram may have all sides equal and not be a square.

*17. If the base of a parallelogram is doubled and the altitude is unchanged, what change is made in the area?

*18. If the altitude of a parallelogram is doubled and the base is unchanged, what change is made in the area?

*19. If both the base and the altitude of a parallelogram are doubled, what change is made in the area?

*20. Draw two parallelograms which are equal in area but have different bases and altitudes.



LET'S PRACTICE

a

$$1. 60060 - 18076 = ?$$

$$2. 9366 \div 18 = ?$$

$$3. .752 - .748 = ?$$

$$4. 1.728 \div 1.2 = ?$$

$$5. 763 + 908 + 1456 + 72 + 5360 + 427 = ?$$

$$6. 3\frac{3}{4} + 2\frac{7}{8} + 9\frac{1}{2} + 6\frac{2}{3} + 2\frac{3}{8} = ?$$

b

$$9\frac{1}{4} - 8\frac{5}{6} = ?$$

$$54 \div \frac{6}{7} = ?$$

$$.09 \times 3.6 = ?$$

$$.6 \div .03 = ?$$

$$3.7 \times 9.4 = ?$$

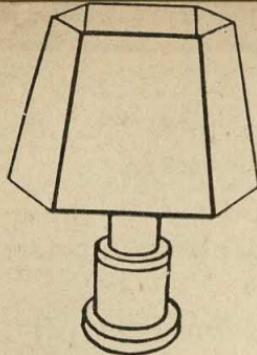
$$6\frac{1}{4} \times 4\frac{2}{5} = ?$$

$$5\frac{1}{6} \div 3\frac{1}{3} = ?$$

$$58.32 \div 32.4 = ?$$

c





THE TRAPEZOID

1. How many sides has each face of the lamp shade in Jack's study? How many of these sides are parallel? not parallel?
2. What do you call a 4-sided figure that has only two sides parallel?

Jack's house is built on a lot shaped like the trapezoid (Fig. A). Harry's house is built on a rectangular lot (Fig. B). Harry said that his lot is the larger, but he could not prove his statement. Jack showed him how to find the area of a trapezoid.

"Cut out two trapezoids of equal size," said Jack. "One of the parallel sides of a trapezoid is known as its upper base and the other as its lower base." How are these bases marked in Figure A?

"Place the two trapezoids in the position shown (Fig. C). What kind of a figure is formed by the two trapezoids? The base of this figure is $a + b$, or the sum of the upper base and the lower base of either trapezoid.

"How does the altitude of each trapezoid compare with the altitude of the parallelogram?

"The area of the parallelogram is how many times as much as the area of each trapezoid?

"From this work," continued Jack, "we can make a rule and a formula for the area of a trapezoid."

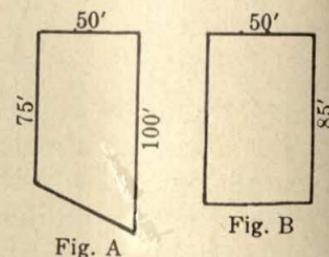


Fig. A

Fig. B

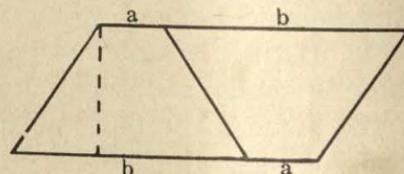


Fig. C

RULE: The area of a trapezoid is equal to one half the product of the altitude and the sum of the bases.

FORMULA: $A = \frac{1}{2}h(a + b)$. The signs () are parentheses. They indicate that a is to be added to b before multiplying by h .

What does each letter represent in the formula?

Find the area of the following trapezoids:

ALTITUDE	UPPER BASE	LOWER BASE	ALTITUDE	UPPER BASE	LOWER BASE
1. 8 ft.	7 ft.	12 ft.	4. $4\frac{1}{2}$ ft.	5 ft.	9 ft.
2. 3 mi.	2 mi.	5 mi.	5. $5\frac{1}{2}$ yd.	7 yd.	10 yd.
3. 4.6 ft.	6.3 ft.	9.8 ft.	6. 1.5 ft.	3.5 ft.	8.0 ft.
7. Which lot was the larger, Jack's or Harry's (page 46)? How much larger?					

*8. If the altitude of a trapezoid is doubled but the other dimensions remain unchanged, how has the area been changed?
*9. Show by substituting numbers in the formula $A = \frac{1}{2}h(a + b)$ that either of the following rules may be used to find the area of a trapezoid:

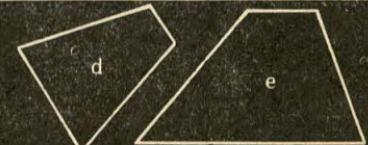
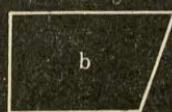
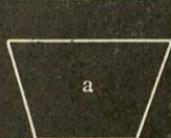
a. RULE: The area of a trapezoid is equal to one half of the altitude multiplied by the sum of the bases.

b. RULE: The area of a trapezoid is equal to one half of the sum of the bases multiplied by the altitude.

*10. Which rule would be the easier to use in finding the area of trapezoids whose dimensions are:

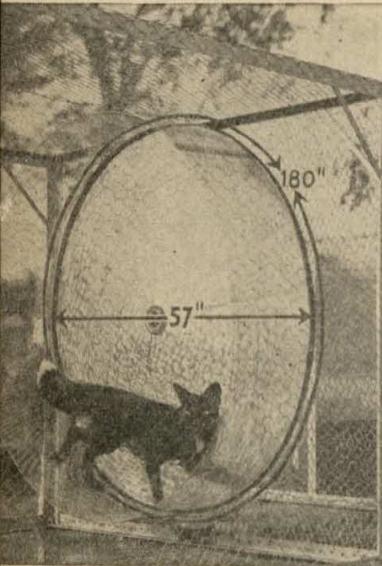
a. $h = 8, a = 7, b = 12$ b. $h = 9, a = 6, b = 10$

11. Which of the following figures are trapezoids?



e

THE FOX WHEEL



Jim's father has a fox farm. The foxes are given exercise by putting them on a fox wheel with a treadmill.

1. Jim measured the diameter of the fox wheel. How long is this diameter in inches? in feet?
2. Jim measured the circumference of the fox wheel. How long is the circumference in inches? in feet?
3. Jim divided the circumference by the diameter. His quotient was $3\frac{1}{7}$. Check Jim's answer.

4. Then Jim remembered the rule which he had learned for finding the circumference of a circle. Copy this rule and insert the missing number.

RULE: The circumference of a circle is about (?) times as long as its diameter.

5. Change this rule (problem 4) to a formula by using C for circumference and d for diameter.
6. The ratio of the circumference of a circle to its diameter is about 3.14; $3\frac{1}{7}$; or $\frac{22}{7}$. This ratio, as you recall, is spelled **PI**, pronounced **PIE**, and written π . Write the formula for finding the circumference of a circle (problem 5) but use π in place of $3\frac{1}{7}$.
7. If $d = 8$, what is r ? If $r = 5\frac{1}{2}$, what is d ?
8. As $d = 2r$, the formula for the circumference of a circle may also be written $C = 2\pi r$. Write this formula as a rule.

RADIUS, DIAMETER, CIRCUMFERENCE

1. A circular fountain is 10 feet in diameter. What is the distance around the fountain?

The distance around the fountain is its **circumference**.

$$d = 10; C = ?; C = \pi d. C = \frac{22}{7} \times 10 = \frac{220}{7} \text{ or } 31\frac{3}{7}$$

2. Solve problem 1 by using the formula $C = 2\pi r$. Show that the result will be the same.

Find the missing values: (Use $\pi = \frac{22}{7}$)

3.	a	b	c	d	e
$d =$	21 in.	9 ft.	5 yd.	4 rd.	1 mi.
$C =$?	?	?	?	?

4.	r	8 in.	$3\frac{1}{2}$ ft.	1.5 mi.	36 cm.	8 m.
	$C =$?	?	?	?	?

5. The diameter of an automobile wheel is 28 inches. How far will the car move in one revolution of the wheel?

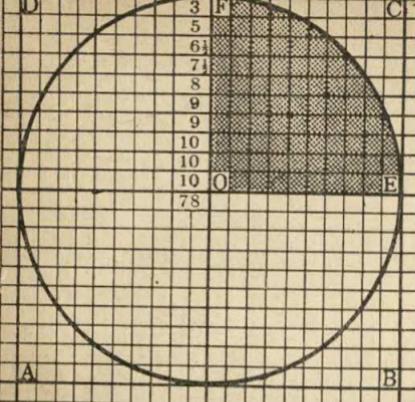
6. How many revolutions, to the nearest whole number, will the wheel of the car (problem 5) make in going a mile? (5280 ft. = 1 mi.)

7. Show that a circular running track, having a diameter of 140 yards, will have a circumference of a quarter of a mile (440 yards).

*8. If the diameter of a circle is doubled, what effect has that on the circumference? on the radius?

*9. If the radius of a circle is doubled, what effect has that on the circumference? on the diameter?

*10. If the circumference of one circle is twice as large as the circumference of another circle, show that the diameter of the one circle will be twice as large as the diameter of the other circle.



AREA OF A CIRCLE

David read in his arithmetic book that a circle having the same diameter as a square is .78 of the area of the square. He also read that the area of a circle may be found by the formula $A = \pi r^2$. He wondered whether or not

these statements were correct so:

- He drew on graph paper a square, $ABCD$, with a side of 20 units.
- Within this square he drew a circle with a diameter of 20 units, radius 10 units.
- In the formula $A = \pi r^2$, David substituted 3.14 for π , 10 for r , and found the area to be $3.14 \times 100 = 314$.
- He used radius OE as the side of a square and found the area of $OECF$ to be $10 \times 10 = 100$.
- He shaded the part of the circle contained within the square $OECF$.
- He counted all the shaded squares and all squares half or more shaded. How many was this?
- David said, "There are 100 small squares in one fourth the square $ABCD$. There are 78 shaded squares (all or more than half shaded) in one fourth of the circle. Therefore the area of the circle is $\frac{78}{100}$, or .78, or 78% of the area of the square $ABCD$."

If David counted 78 squares in one fourth of a circle, how many squares are in the circle? How many squares would he have found by using the formula $A = \pi r^2$? These answers differ by 2 squares. Why?

From this work David proved that his rule and formula for finding the area of a circle are correct.

RULE: The area of a circle is equal to π times the square of the radius.

FORMULA: $A = \pi r^2$. (r^2 means $r \times r$, read "r-square.")

1. A circular pond is 8 feet in diameter. Find its area.

$$d = 8$$

$$r = 4$$

$$A = \pi r^2$$

$$A = \frac{22}{7} \times 4 \times 4 = \frac{352}{7} = 50\frac{2}{7}$$

Find the area of a circle having a radius of: ($\pi = \frac{22}{7}$)

2. 3 ft. 4. 1 in. 6. 25 in. 8. 14 ft.
3. 9 yd. 5. 24 cm. 7. 2 mi. 9. $3\frac{1}{2}$ yd.
10. From a fire tower on top of a mountain, a forest ranger can see 21 miles in every direction on a clear day. What is the number of square miles over which he can keep watch?

11. If a circular skating rink is 100 feet in diameter, how much skating surface does it have?

*12. Two circles which have the same center are called **concentric circles**. If two concentric circles have radii of 12 feet and 8 feet respectively, find the areas of the two circles. Find the difference in the areas of these two circles.

*13. Decide which of the following statements are true and which are **false**.

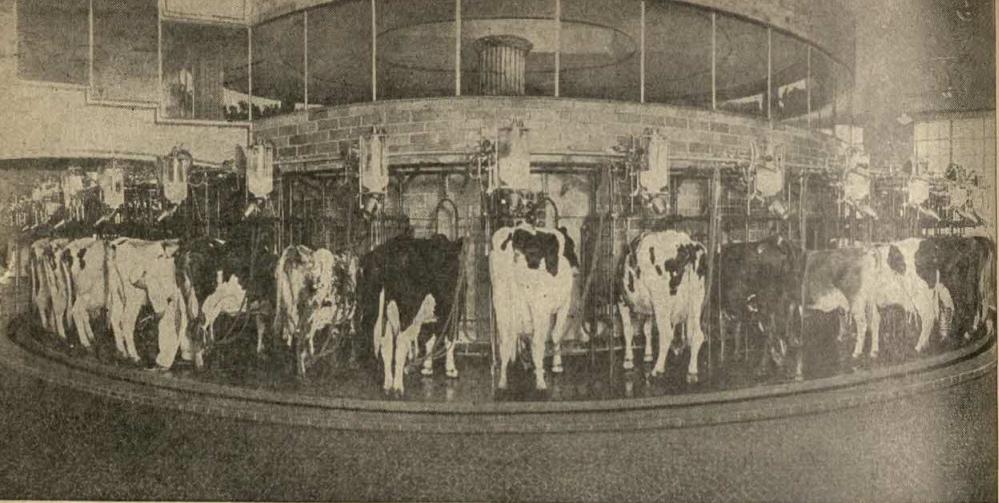
a. If two circles have equal diameters, their areas are equal.

b. If two circles have equal circumferences, their areas are equal.

c. If the radius of a circle is 1, the area is about 1.

d. If the radius of a circle is doubled, the circumference is doubled.

e. If the radius of a circle is doubled, the area is doubled.



THE ROTOLACTOR

The rotolactor has places for 50 cows on its platform. A cow steps on, rides around once, is milked, and steps off, all in $12\frac{1}{2}$ minutes.

1. If the diameter of the rotating platform is 60 feet, what is its circumference? (Use $\pi = 3.14$)
2. If the rotolactor makes one revolution in $12\frac{1}{2}$ minutes, how far does a point on the circumference move in 1 minute? (Give answer to nearest tenth of a foot.)
3. If 50 cows can be milked in $12\frac{1}{2}$ minutes, at that rate how many can be milked in one hour?
4. How long does it take to milk the 1680 cows in the herd at the dairy?
5. Eight cows an hour is a good record for milking by hand. At that rate, how many men would be required to milk 1680 cows in 6 hours?
- *6. How does the use of milking machines affect the number of people employed?
- *7. Do you think the price of milk would be more, or less, a quart than it now is if milking machines were not used?

A GIANT EYE

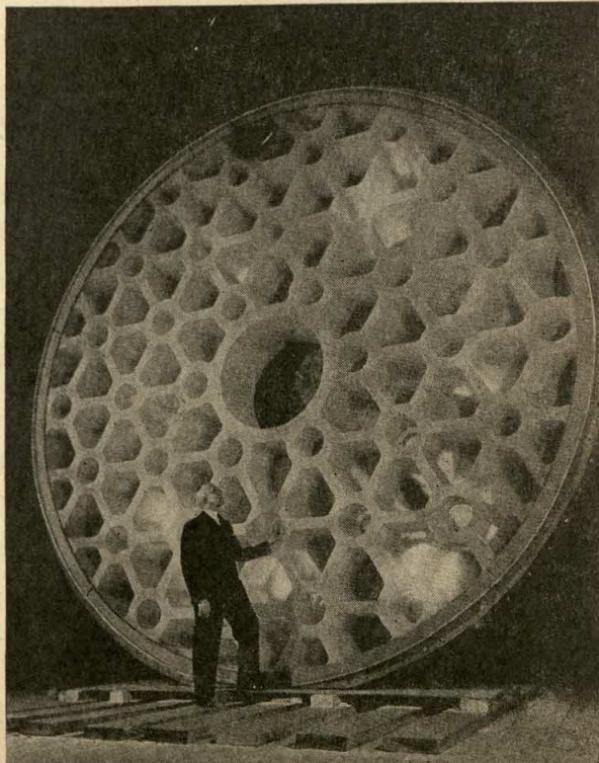
The largest telescope in the world, on Palomar Mountain, California, has a lens 200 inches in diameter. The second largest telescope, also in California, on Mt. Wilson near Pasadena, has a lens 100 inches in diameter.

1. What is the diameter in feet of the lens of the Mt. Wilson telescope? of the lens of the telescope on Palomar Mountain?

2. The 100-inch lens has 160,000 times the light-gathering capacity of the human eye. The 200-inch lens has 640,000 times the light-gathering capacity of the human eye. The larger lens is how many times as powerful as the smaller?

*3. State why the larger telescope should have about four times as much light-gathering power as the smaller. (HINT: Consider the diameters.)

*4. Light from stars 1,200,000,000 **light years** distant can be seen with the 200-inch lens. A **light year**, as you recall, is the distance light travels in a year at the rate of about 186,000 miles a second. Is a light year more or less than 6 trillion miles? (1 yr. = $365\frac{1}{4}$ da.)





HOW WELL DO YOU REMEMBER?



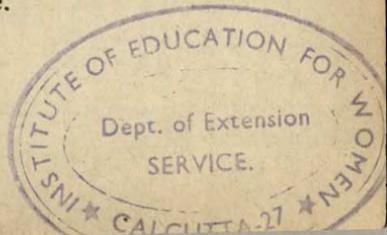
1. What is the difference between the perimeter of a figure and its area?
2. If a square has a side of 1 inch, what is its perimeter? its area?
3. If a circle has a radius of 1 foot, what is its circumference? its area? (Use $\pi = 3.14$)
4. Find the area of rectangles whose dimensions are as follows: *a.* length, 6 in.; width, 4 in.; *b.* length, 16 ft.; width, 9 ft.; *c.* length, 42 cm.; width, 29 cm.
5. Find the perimeters of squares whose sides are: *a.* 9 in.; *b.* $2\frac{1}{2}$ in.; *c.* 18 ft.; *d.* 3.5 yd.
6. Find the area of each square given in problem 5.
7. What is an equilateral triangle? an isosceles triangle? a scalene triangle? Draw an example of each of these triangles.
8. If the side of an equilateral triangle is s , write a formula for its perimeter. Find p when $s = 18$.
9. Draw a right triangle; an obtuse triangle; an acute triangle which is not equilateral.
10. Find the area of triangles when: *a.* $b = 9$ in. and $h = 14$ in.; *b.* $b = 7$ ft. and $h = 9$ ft.
11. Find the area of parallelograms when: *a.* $b = 7$ yd. and $h = 5$ yd.; *b.* $b = \frac{1}{8}$ mi. and $h = \frac{1}{4}$ mi.
12. Find the area of trapezoids when: *a.* $h = 6$ in., $a = 5$ in., and $b = 8$ in.; *b.* $h = 9$ ft., $a = 7$ ft., and $b = 10$ ft.
13. All rectangles are parallelograms, but all parallelograms are not rectangles. Why?
14. If a diagonal of a rectangle is drawn, what kind of triangles are formed?

THINGS TO REMEMBER

1. To use formulas for areas and perimeters of most plane figures having three or four sides.
2. To use formulas for the circumference and the area of a circle.
3. How to substitute numbers for letters in a formula.

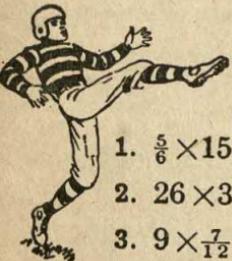
TEST ON CHAPTER II

1. If the side of a square is 9 inches, what is its perimeter? its area?
2. A rectangle is 40 feet wide and 75 feet long. What is its area?
3. Find A in the formula $A = \frac{1}{2}h(a + b)$, when $h = 4$, $a = 7$, and $b = 10$.
4. Find A in the formula, $A = \frac{1}{2}bh$, when $b = 24$ and $h = 15$.
5. Find C in the formula, $C = 2\pi r$, when $r = 3\frac{1}{2}$.
($\pi = \frac{22}{7}$)
6. Find A in the formula, $A = \pi r^2$, when $r = 7$. ($\pi = \frac{22}{7}$)
7. If the height of a step is s , what will be the height of 5 of these steps?
8. What is the difference between an isosceles triangle and an equilateral triangle? Draw one of each kind.
9. What is the difference between an obtuse triangle and a right triangle? Draw one of each kind.
10. What is the difference between a rectangle and a parallelogram? between a parallelogram and a trapezoid?
11. If the side of an equilateral triangle is s , show that its perimeter is $3s$. Using the formula $p = 3s$, find p when $s = 4\frac{1}{2}$ inches.
12. Write the formula for the area of: *a.* a parallelogram; *b.* a triangle; *c.* a trapezoid; *d.* a circle.



*TOPICS FOR SPECIAL REPORTS

1. Show that a triangle is rigid but that a figure of four or more sides is not. Where are triangular figures used very frequently? Why?
2. Make a list of at least ten different things which are in the shape of a trapezoid, as for example, sides of waste-baskets.
3. Divide a circle into 8 equal parts. Arrange these parts so that they almost form a parallelogram. Since the base of the parallelogram is half of the circumference, show that the formula for the area of a circle may be found by substituting πr ($\frac{1}{2}C$) in the formula for the area of a parallelogram.
4. Make a drawing for each of the following figures having four sides: a. quadrilateral; b. rectangle; c. rhombus.
5. Find the number of acres in a football field.



LET'S PRACTICE

3

$$1. \frac{5}{6} \times 15 = ?$$

$$2. 26 \times 3\frac{3}{4} = ?$$

$$3. 9 \times 7\frac{7}{12} = ?$$

$$4. 3.7 \times .068 = ?$$

$$5. 1\frac{2}{3} - \frac{3}{4} = ?$$

$$6. 1 \div \frac{7}{8} = ?$$

$$7. .900 - .358 = ?$$

$$8. 7\frac{3}{8} + 16\frac{2}{3} + 5\frac{1}{4} + 9\frac{1}{2} + 14 + 12\frac{7}{8} = ?$$

$$9. 5.49 + 0.98 + 16.30 + 7.64 + 6.04 = ?$$

$$10. 24 \div \frac{2}{3} = ?$$

$$11. 306 \times 508 = ?$$

$$12. 78.4 \div .28 = ?$$

$$13. 14 - 4\frac{7}{8} = ?$$

$$14. .0912 \div 16 = ?$$

$$15. 2\frac{3}{8} \times 5\frac{1}{4} = ?$$

$$16. 7\frac{1}{2} \times 3\frac{1}{3} = ?$$

$$17. 86 \times 4\frac{1}{2} = ?$$

$$18. .25 \times .25 = ?$$

$$19. 806 \times 739 = ?$$

$$20. .01 \div 2 = ?$$

TO A NEW CHAPTER

CHAPTER III

HERE'S WHERE THE MONEY GOES

"Here's Where the Money Goes" shows retail sales per capita (a person) in the United States.

1. What per cent represents the total sales per capita?
2. If about 23% of retail sales are made by food stores, what per cent remains for other retail merchants?
3. What per cent of retail sales are made by merchants other than auto dealers and gas stations?
4. Add the per cents on the graph. Check your sum against the per cent in problem 1. Do they agree? Why?
5. What per cent less was spent for automobiles than for food? (HINT: Would you combine restaurants with food stores? filling stations with auto dealers?)
6. If the Davis family of 5 persons spends as in the graph, how much a year do their purchases cost?
7. How much does the Davis family spend for food? for each of the other items in the chart?
- *8. If your family bought as shown in the chart, how much would it spend for each item? for all the items?



FOOD STORES
\$93 - 23%



AUTO DEALERS
\$64 - 16%



GENERAL MERCHANDISE
\$58 - 14%



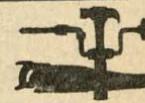
RESTAURANTS
**\$32
8%**



APPAREL STORES
\$31 - 8%



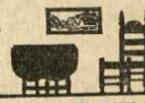
HARDWARE ETC.
\$28 - 7%



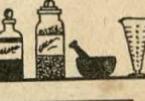
FILLING STATIONS
\$26 - 6%



FURNITURE STORES
\$20 - 5%



DRUG STORES
\$14. - 3%



ALL OTHERS
\$42 - 10%



DIAGNOSTIC TESTS IN PERCENTAGE

I. Write the following per cents as decimals:

1. 5%	3. 15%	5. 2.5%	7. 1.25%
2. 40%	4. $1\frac{1}{2}\%$	6. 10%	8. 1%

II. Write the following decimals as per cents:

1. .25	3. .6	5. .03	7. .125
2. .0225	4. .405	6. .1	8. .025

III. Write the following per cents as fractions:

1. 25%	3. 50%	5. 10%	7. 75%
2. $33\frac{1}{3}\%$	4. $12\frac{1}{2}\%$	6. 80%	8. $16\frac{2}{3}\%$

IV. Write the following fractions as per cents:

1. $\frac{3}{4}$	3. $\frac{1}{5}$	5. $\frac{1}{3}$	7. $\frac{1}{2}$
2. $\frac{1}{6}$	4. $\frac{1}{4}$	6. $\frac{3}{5}$	8. $\frac{2}{3}$

V. Find the missing numbers in the following:

1. 10% of 50 = ?	7. 25% of 60 = ?
2. 15% of 75 = ?	8. 30% of 120 = ?
3. 4% of 45 = ?	9. 20% of 15 = ?
4. 1% of 80 = ?	10. 100% of 24 = ?
5. 45% of 16 = ?	11. 50% of 5 = ?
6. 2% of 250 = ?	12. $1\frac{1}{2}\%$ of 60 = ?

VI. Find the missing per cents in the following:

1. 3 = ? % of 6	7. 15 = ? % of 60
2. 4 = ? % of 40	8. 7 = ? % of 21
3. 6 = ? % of 8	9. 9 = ? % of 100
4. 15 = ? % of 15	10. 32 = ? % of 80
5. 60 = ? % of 360	11. 120 = ? % of 600
6. 3 = ? % of 200	12. 2.5 = ? % of 100

If you missed any of the examples in the test, you will find similar examples for practice on pages 59-61, 65-66. The test is keyed to the practice work. Section I in the test, to illustrate, has the same kind of examples as Section I on page 59.

PRACTICE IN PER CENTS—I-II

Per cent, as you have learned, means hundredths. In the 4 examples shown below, per cents have been changed to decimals. Read each example, then work it on paper.

$$12\% = .12$$

$$3\% = .03$$

$$40\% = .40 = .4$$

$$2\frac{1}{2}\% = 2.5\% = .025$$

a. In working each example, tell what was done with the per cent sign; the decimal point.

b. Write the rule for changing a per cent to a decimal.

I. Write as decimals:

$$1. 16\%$$

$$2. 4\%$$

$$3. 80\%$$

$$4. 3.5\%$$

$$5. 30\%$$

$$6. 4.25\%$$

$$7. 1\frac{1}{2}\%$$

$$8. 5\frac{1}{4}\%$$

$$9. 12\frac{1}{2}\%$$

$$10. 6.7\%$$

$$11. 1\%$$

$$12. 10\%$$

$$13. 2\frac{1}{4}\%$$

$$14. 3\frac{3}{4}\%$$

$$15. 5.2\%$$

$$16. 1.45\%$$

In the 6 examples shown below, decimals have been changed to per cents. Read each example, then work it on paper.

$$.15 = 15\%$$

$$.6 = .60 = 60\%$$

$$.04 = 4\%$$

$$.125 = 12.5\%$$

$$.015 = 1.5\%$$

$$.005 = .5\%$$

a. In working each example, the per cent sign was moved how many places? toward the left or right?

b. Write the rule for changing a decimal to a per cent.

II. Write as per cents:

$$1. .14$$

$$2. .65$$

$$3. .1$$

$$4. .875$$

$$5. .01$$

$$6. .025$$

$$7. .8$$

$$8. .6$$

$$9. .05$$

$$10. .375$$

$$11. .6667$$

$$12. .33\frac{1}{3}$$

$$13. .134$$

$$14. .023$$

$$15. .9$$

$$16. .09$$

$$17. .0325$$

$$18. .445$$

$$19. .105$$

$$20. .66\frac{2}{3}$$

PRACTICE IN PER CENTS—III

Any number which is written as a per cent may be written also as a fraction.

Express 25% as a fraction.

$$25\% = \frac{25}{100} = \frac{1}{4}$$

- a. In working the example what sign was dropped?
- b. The per cent was written as a fraction having what denominator?
- c. How was the fraction reduced to lowest terms?
- d. Write the rule for changing a per cent to a fraction.

III. Write the following per cents as fractions:

1. 10%	3. 50%	5. 75%	7. 30%	9. 4%
2. 15%	4. 40%	6. 5%	8. 45%	10. 12%

Express $16\frac{2}{3}\%$ as a fraction.

$$16\frac{2}{3}\% = \frac{16\frac{2}{3}}{100}$$

$$\frac{3 \times 16\frac{2}{3}}{3 \times 100} = \frac{50}{300}$$

Multiply both numerator and denominator by 3, the denominator of the given fraction.

$$16\frac{2}{3}\% = \frac{50}{300} = \frac{1}{6}$$

Explain each step in the work.

$$16\frac{2}{3}\% = \frac{1}{6}$$

Express as fractions:

11. $12\frac{1}{2}\%$	14. $87\frac{1}{2}\%$	17. $83\frac{1}{3}\%$	*20. $18\frac{3}{4}\%$
12. $62\frac{1}{2}\%$	15. $66\frac{2}{3}\%$	18. $2\frac{1}{2}\%$	*21. $56\frac{1}{4}\%$
13. $33\frac{1}{3}\%$	16. $37\frac{1}{2}\%$	*19. $6\frac{1}{4}\%$	*22. $6\frac{2}{3}\%$

PRACTICE IN PER CENTS—IV

Edith was given $\frac{1}{4}$ of the money she received from the sale of Christmas cards. What per cent did she receive?

$\frac{1}{4} = .25 = 25\%$ Edith received 25% of the sales price.

Express $\frac{3}{8}$ as a per cent.

$$\begin{array}{r} .375 \\ 8 \overline{)3.000} \\ 24 \\ \hline 60 \\ 56 \\ \hline 40 \\ 40 \end{array}$$

You know that
 $.375 = 37.5\%$.
 So $\frac{3}{8} = 37.5\%$
 or $\frac{3}{8} = 37\frac{1}{2}\%$

Express $\frac{5}{6}$ as a per cent.

$$\begin{array}{r} .83\frac{1}{3} \\ 6 \overline{)5.00} \\ 48 \\ \hline 20 \\ 18 \\ \hline 2 \end{array}$$

You know that
 $.83\frac{1}{3} = 83\frac{1}{3}\%$.
 So $\frac{5}{6} = 83\frac{1}{3}\%$

To change a fraction to a per cent, divide the numerator by the denominator, carry the result to two decimal places, and then express the quotient as a per cent.

IV. Change the following fractions to per cents:

1. $\frac{1}{2}$	4. $\frac{1}{7}$	7. $\frac{1}{16}$	10. $\frac{9}{16}$	13. $\frac{4}{15}$
2. $\frac{5}{8}$	5. $\frac{2}{5}$	8. $\frac{5}{7}$	11. $\frac{5}{9}$	14. $\frac{9}{14}$
3. $\frac{5}{16}$	6. $\frac{7}{8}$	9. $\frac{3}{5}$	12. $\frac{7}{12}$	15. $\frac{15}{16}$

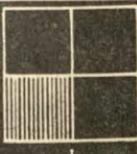
Memorize the per cent value of each of the following fractions. They are used frequently.

$$\begin{array}{lll} \frac{1}{2} = 50\% & \frac{2}{3} = 66\frac{2}{3}\% & \frac{3}{4} = 75\% \\ \frac{1}{3} = 33\frac{1}{3}\% & \frac{1}{4} = 25\% & \frac{1}{5} = 20\% \\ & & \frac{2}{5} = 40\% \\ & & \frac{3}{5} = 60\% \end{array}$$

16. What per cent of each figure is shaded?



a.



b.



c.



d.



e.

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PROTECT YOUR EYES

1. How many senses have we?
2. They are "serving men" who tell us about our world and the people in it. Which sense is most helpful to us? List the other senses in order of helpfulness.
3. The sense of sound is how many times as valuable as the sense of smell? of touch? of taste?
4. The sense of sight is about how many times as valuable as the sense of sound? of smell? of touch?
5. We depend on sight more than upon all the other senses. How much more?
6. Two serving men, our eyes, tell us what per cent of all we know? What per cent do we learn through our other senses? Work this problem by use of the picture. Then work it without the picture. (HINT: What per cent represents all that we learn from our senses?)
- *7. How does the graph show that we must protect our sight above all other senses? What are some ways of protecting the eyes?
- *8. If a person were blind, which of the other senses probably would help him most?

CHECKING AIR IN TIRES

"See that automobile tire," said Ralph. "It is so soft that the side walls are cracking. The owner must keep it inflated (swelled with air) to a pressure recommended by the manufacturer, or the tire won't give good mileage." How much mileage may be lost by underinflation is shown in the graph.

1. How do you measure the amount of air in a tire?

2. If a tire is 80% inflated, about what per cent of the mileage in the tire will it yield?

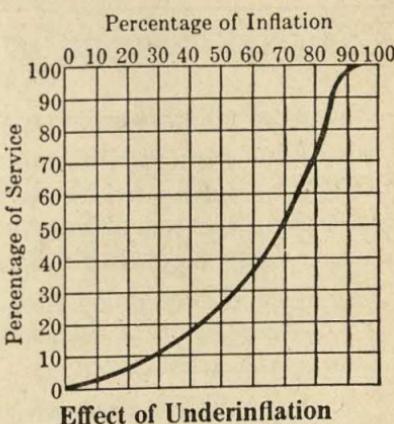
3. If a tire is supposed to be inflated to 40 pounds but is inflated only to 30 pounds, how will its mileage be affected?

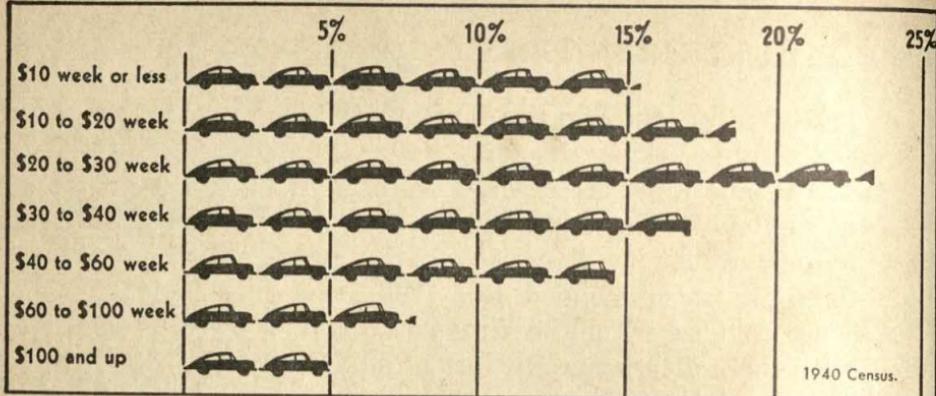
4. A manufacturer guaranteed his tire to run 20,000

miles if kept inflated to 35 pounds. If the tire is kept inflated to 28 pounds, what would be the expected mileage?

5. Another manufacturer guaranteed his tire for 20,000 miles if kept inflated to 30 pounds. Mr. Grayson bought one, inflated it to 15 pounds, and expected to get 10,000 miles. About how much mileage did he get?

*6. If a tire is inflated to 40 pounds, would the pressure be more, or less, after driving on a hot day? How does heat affect the amount of pressure in tires? the speed of the car?





MONEY INCOME OF AUTOMOBILE-OWNING FAMILIES

1. About what per cent of the families owning automobiles have a money income of \$10 or less a week?
2. If a family's money income averages \$10 a week, how much is that a year?
3. About what per cent of the families owning automobiles have a money income of \$100 or more a week?
4. If a family's income averages \$100 a week, how much is that a year?
5. About what per cent of families owning automobiles have weekly incomes from \$10 to \$20? from \$20 to \$30? from \$30 to \$40? from \$40 to \$60? from \$60 to \$100?
6. One family drives its car 7500 miles a year and averages 15 miles to a gallon of gasoline at 17¢ a gallon. Find the yearly cost of the gasoline.
- *7. A family has a weekly income of \$20. How much money would it have after paying for the gasoline in problem 6? Can a family in this income group afford to drive a car 7500 miles a year? Explain.
- *8. How much do you think the family money income should be in order to afford a car?

PRACTICE IN PER CENTS—V

1. Mr. Martin bought a house for \$3250, paying 25% in cash. How much was the cash payment?

Method I

$$\begin{array}{rcl} 25\% & = .25 & \$3250 \\ & \times .25 & \\ \hline & 16250 & \\ & 6500 & \\ \hline & \$812.50 & \end{array}$$

Method II

$$25\% = \frac{1}{4}$$

$$\frac{1}{4} \times \$3250 = \$812.50$$

The cash payment was \$812.50. Which method is easier?

a. In Method I how was the per cent changed? in Method II?

b. In Method I by what was the cost of the house multiplied? in Method II?

c. Write the rule for finding the per cent of a number.

2. You are to find 46% of a number. Will you express 46% as a decimal or as a common fraction? Why?

V. Find the missing number in each of the following examples. (Solve examples 3-12 without use of pencil.)

3. 10% of 50 = ?

13. 24% of 65 = ?

4. 1% of 80 = ?

14. $12\frac{1}{2}\%$ of 72 = ?

5. 5% of 200 = ?

15. 15% of 125 = ?

6. 100% of 16 = ?

16. 50% of 375 = ?

7. 25% of 100 = ?

17. $2\frac{1}{2}\%$ of 450 = ?

8. 6% of 60 = ?

18. 35% of 145 = ?

9. 20% of 50 = ?

19. 9% of 765 = ?

10. 4% of 300 = ?

20. 87.5% of 250 = ?

11. $33\frac{1}{3}\%$ of 75 = ?

21. 37.5% of 620 = ?

12. 40% of 200 = ?

22. 4.5% of 1450 = ?

23. A new automobile loses about 35% of its value the first year of use. If the car cost \$960 new, about how much is it worth at the end of its first year?

PRACTICE IN PER CENTS—VI

1. In a class of 36 pupils, there were 24 boys. What per cent of the class was boys?

The number of boys was $\frac{24}{36}$ $\frac{24}{36} = \frac{2}{3} = 66\frac{2}{3}\%$
of the number of pupils.

2. A basketball team won 11 of its 15 games. What per cent of its games did it win?

$$\begin{array}{r} .73\frac{1}{3} \\ \hline 11 \\ 15 = 15) 11.00 \\ \underline{105} \\ 50 \\ 45 \\ \hline 5 \end{array}$$
 The number of games won was $\frac{11}{15}$ of the number played. Change $\frac{11}{15}$ to hundredths.
 $.73\frac{1}{3} = 73\frac{1}{3}\%$

They won $73\frac{1}{3}\%$ of the games played.

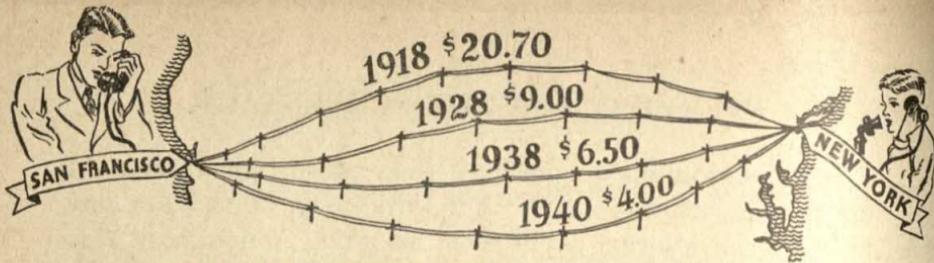
To find what per cent one number is of another: Write the numbers as a fraction. The number compared is the numerator and the number with which it is compared is the denominator. Then change the fraction to a per cent.

VI. Find the missing number in each of the following examples. (Solve examples 3–12 without use of pencil.)

3. $4 = ? \%$ of 8	13. $15 = ? \%$ of 40
4. $9 = ? \%$ of 12	14. $35 = ? \%$ of 90
5. $2 = ? \%$ of 10	15. $140 = ? \%$ of 175
6. $25 = ? \%$ of 75	16. $160 = ? \%$ of 600
7. $1 = ? \%$ of 20	17. $110 = ? \%$ of 160
8. $5 = ? \%$ of 100	18. $210 = ? \%$ of 450
9. $1 = ? \%$ of 100	19. $500 = ? \%$ of 750
10. $50 = ? \%$ of 200	20. $120 = ? \%$ of 720
11. $6 = ? \%$ of 6	21. $90 = ? \%$ of 1000
12. $5 = ? \%$ of 50	22. $360 = ? \%$ of 1440

EVERYDAY USES OF PERCENTAGE

1. If customers do not pay their store bills within six months, merchants know that only 67% of the amount due (on the average) will ever be paid. A merchant has \$750 owing to him on which nothing has been paid for 6 months. How much will he probably be able to collect?
2. A tennis club has a membership of 68. If 75% of the members are boys, how many in the club are boys?
3. Eighteen of the 32 pupils in an eighth-grade class are girls. What per cent of the class is girls?
4. If a school basketball team played 16 games and won 11 of them, what per cent of the games did it win? What per cent did it lose?
5. A pair of shoes, regularly priced at \$4.50, was sold at a "special sale" for \$3.75. What was the per cent reduction?
6. Twenty-three out of every 1000 people in the United States are college graduates. What per cent of our total population is college graduates?
7. How many college graduates are there in the United States? (Use 132,000,000 as the estimated population.)
- *8. Edward raised 8 tons of sugar beets which tested 13.6% of their weight in sugar. How many pounds of sugar should Edward get from the beets?
- *9. Of 100 pupils, 75 are in elementary school, 21 in high school, and 4 in college. If 25% of our population of 132,000,000 is in school, how many are in each kind of school?
- *10. The standard weight of a dozen eggs is 23 ounces. A poultryman found that his hens' eggs averaged 10% more than the standard. What was the average weight of a dozen of these eggs? of each egg?



OUR CHANGING TELEPHONE RATES

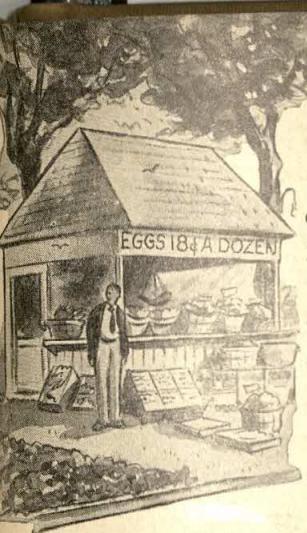
The first transcontinental telephone call (New York-San Francisco) was made in 1915. It cost \$20.70. Today the same call would cost about \$4.00.

1. What was the per cent reduction in the charge?
2. During one 10-year period, the charge for a 3-minute telephone call between New York and San Francisco dropped from \$9.00 to \$6.50. Find the per cent reduction.
3. "Old" and "new" telephone rates are shown in the following table. Find the per cent reduction in rates.

STATIONS	DAY RATE		PER CENT REDUCTION	NIGHT AND SUNDAY		PER CENT REDUCTION
	OLD	NEW		OLD	NEW	
New York to San Francisco	\$6.50	\$4.00	?	\$4.25	\$3.00	?
Chicago to Los Angeles	4.75	3.50	?	3.25	2.50	?
Boston to Chi- cago	2.50	2.00	?	1.50	1.40	?
Oklahoma City to New York	3.75	2.80	?	2.25	1.95	?
New York to Minneapolis	2.90	2.40	?	1.75	1.60	?

4. Is the per cent reduction in day rates the same between any two stations, or different?
5. Is the per cent reduction in night and Sunday rates the same as for day rates or different?

PRICES ARE NOT FIXED



Mr. Brooks keeps a record of the price received for eggs from his poultry farm. He found that the average selling price of eggs is lowest in May and highest in December.

The per cent increase or decrease is always figured on the number from which the change is made.

1. If the average price of a dozen eggs is 18¢ in May and 54¢ in December, what is the increase in price? the per cent increase?
2. What is the decrease in price of a dozen eggs from 54¢ in December to 18¢ in May? the per cent decrease?
3. During November, the price of a dozen eggs increased from 32¢ to 40¢. What was the per cent increase?
4. During March, the price of a dozen eggs decreased from 40¢ to 32¢. What was the per cent decrease?
5. Study the results of problems 1-4. Then answer the following questions:
 - a. Can the per cent increase be greater than 100%? Explain.
 - b. Must the per cent decrease always be less than 100%? Explain.
 - *c. If an article increases 25% in cost and then drops to the original price, what is the per cent decrease? How much more or less is this than 25%?
- *6. What are some things which cause the price of eggs to increase? decrease?

PER CENTS TO THE NEAREST TENTH

1. A merchant found that for every \$19 of expense in running his business, \$10.20 was used to pay salaries. The salaries represented what per cent of the expenses?

.5368 = .537 to the nearest thousandth

$ \begin{array}{r} 19)10.2000 \\ \underline{95} \\ 70 \\ \underline{57} \\ 130 \\ \underline{114} \\ 160 \\ \underline{152} \\ 8 \end{array} $	<p><u>.537</u> = 53.7% (to the nearest tenth per cent)</p> <p>Salaries were 53.7% of the expenses.</p> <ul style="list-style-type: none"> a. The quotient was carried to how many decimal places? b. What is the fourth-place figure? Is it 5 or more? c. How was the third-place figure changed? d. Tell how to find per cent to the nearest tenth.
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2. A baseball team won 11 out of 14 games played. Find the per cent of games won, to the nearest tenth per cent.

3. The eighth-grade class of the Lee School made a table which helped them to find quickly the per cent attendance to the nearest tenth per cent. There were 35 pupils enrolled, and the class record showed that there had never been fewer than 28 present. Copy and complete the following table and find the missing values, to the nearest tenth per cent.

Enrolled	35	35	35	35	35	35	35	35
Present	35	34	33	32	31	30	29	28
Per cent attendance	?	?	?	?	?	?	?	?

*4. Make a per-cent attendance table for your class.

PER CENTS GREATER THAN 100 PER CENT

1. What per cent of a quart of milk is a quart of milk?
2. What per cent of a pound of sugar is 2 pounds of sugar? 3 pounds? 4 pounds? 5 pounds?
3. Explain the meaning of the following:
 - a. The population of Millville is 250% of what it was 20 years ago.
 - b. Living costs are 200% of what they were 10 years ago.
4. Rewrite each of the following statements using per cents:
 - a. Harry earns twice as much as he did last year.
 - b. The population of Bay City is three times as great as it was 25 years ago.
5. Write the following as decimals or as whole numbers:
 - a. 210%; b. 150%; c. 100%; d. 103%; e. 225%.
6. Write the following as per cents:
 - a. 1.25; b. 2; c. $2\frac{1}{2}$; d. 1; e. 1.4; f. 3.3.
7. Without pencil, find the missing numbers:

a. \$6 is ? % of \$2	e. 12 ft. is ? % of 3 ft.
b. \$4 is ? % of \$3	f. 50 mi. is ? % of 10 mi.
c. 16 qt. is ? % of 8 qt.	g. 5 bu. is ? % of 4 bu.
d. 30 in. is ? % of 12 in.	h. 12 in. is ? % of 1 ft.
8. If a merchant sells an article at twice the cost, his margin is equal to the cost. The margin is what per cent of the cost?
9. The population of a city increased from 10,000 to 25,000. What was the increase? the per cent increase?
- *10. A baby weighed 8 pounds at birth, and 20 pounds on its first birthday. The increase in weight was how many times the weight at birth? What was the per cent increase?

PER CENTS LESS THAN 1%

"Your money is safe with us," said the bank teller to Tom. "We are a member of the Federal Deposit Corporation." This simply means that the bank pays $\frac{1}{12}\%$ of its deposits to the Government as insurance against loss.

1. The deposits of a bank amount to \$360,000. Find the cost of deposit insurance.

$$\frac{1}{12}\% = \frac{1}{12} \text{ of } 1\% \quad 1\% \text{ of } \$360,000 = \$3600$$

Then, $\frac{1}{12}$ of \$3600, or \$300, will be the cost.

To find a fractional per cent of a number, find 1% of the number and multiply this amount by the given fraction.

Find the following:

<i>a</i>	<i>b</i>	<i>c</i>
2. $\frac{1}{2}\%$ of \$1000	$\frac{1}{2}\%$ of \$2500	$\frac{1}{4}\%$ of \$4000
3. $\frac{3}{4}\%$ of \$12,000	$\frac{1}{8}\%$ of \$20,000	$\frac{1}{2}\%$ of \$900
4. $\frac{1}{12}\%$ of \$900,000	$\frac{1}{12}\%$ of \$480,000	$\frac{1}{10}\%$ of \$15,000
5. $\frac{1}{5}\%$ of 10,000	$\frac{1}{8}\%$ of 100,000	$\frac{1}{2}\%$ of 3800
6. A collector is paid $\frac{1}{2}\%$ for collecting a bill of \$450.		

How much does he receive as his fee?

7. A bank charges 0.1% to collect a bill of \$1850. Find the cost of collection.

8. A certain kind of soap is advertised as $99\frac{44}{100}\%$ pure. What is its percentage of impurity?

9. When the birth rate of a nation exceeds the death rate by 6 out of 1000, what per cent is that?

- *10. In a recent year there were 131 lawyers to every 100,000 population in the United States. Lawyers represent what per cent of our population?

- *11. How many lawyers are there in this country if our population is about 132,000,000?

FINDING A NUMBER FROM ITS FRACTIONAL PART

1. In a city election, $\frac{3}{5}$ of the registered voters cast their ballots. If there were 7314 ballots cast, how many registered voters were in the city?

If $\frac{3}{5}$ of the registered voters is 7314, $\frac{1}{5}$ of the registered voters is $\frac{1}{3}$ of 7314, or 2438. $\frac{5}{5}$ of the registered voters is 5×2438 , or 12,190.

Check: $\frac{3}{5} \times 12,190 = 7314$.

2. Jack said, "If $\frac{3}{5}$ of the registered voters is 7314, the number of those registered can be found by dividing 7314 by $\frac{3}{5}$." Prove that Jack's method also gives the correct answer.

Find the number when:

3. $\frac{2}{3}$ of it = 72

9. $\frac{5}{8}$ of it = 120

4. $\frac{3}{4}$ of it = 96

10. $\frac{4}{9}$ of it = 180

5. $\frac{3}{8}$ of it = 51

11. $\frac{9}{10}$ of it = 540

6. $\frac{5}{6}$ of it = \$4.50

12. $\frac{2}{3}$ of it = $4\frac{1}{2}$

7. $\frac{3}{4}$ of it = \$7.80

13. $\frac{1}{2}$ of it = $11\frac{1}{4}$

8. $\frac{2}{5}$ of it = \$12.60

14. $\frac{1}{8}$ of it = $9\frac{5}{6}$

15. If a car travels 36 miles in $\frac{3}{4}$ of an hour, how far will it travel in one hour at the same rate?

16. A 9-ounce package of cheese sells for 18¢. At that rate, what is the price a pound?

17. A can of peaches, containing 14 fluid ounces, sold for 21¢. At that rate, what is the cost of a quart can of peaches? (32 fluid ounces = 1 quart.)

18. $7 \times ? = 42$ 21. $.05 \times ? = \$96$ 24. $\frac{3}{4}$ of ? = 75

19. $28 \times ? = 375$ 22. $.75 \times ? = 30$ 25. $.75$ of ? = 15

20. $.6 \times ? = 3.6$ 23. $.16 \times ? = 49.6$ 26. $.06$ of ? = 4.26

27. If you know the product of two numbers and one of the numbers, how do you find the other number?

FINDING THE WHOLE FROM A PER CENT

Percentage is used to find:

- a. The per cent of a number
- b. What per cent one number is of another
- c. A number when a per cent of it is given.

The first and second uses you know. The third is explained in this lesson.

1. The Boys' Athletic Association bought a basketball at \$9.60. This was 80% of the regular price of the ball. What was the regular price?

Method I

Think: 80% of ? = \$9.60

$$80\% = .80$$

.80 of the regular price

$$= \$9.60$$

$$\text{or } .80 \text{ of } ? = \$9.60$$

Then, $\$9.60 \div .80 =$ the
regular price

$$\$9.60 \div .80 = \$12$$

$$\text{Check: } .80 \times \$12 =$$

Method II

80% of ? = \$9.60

If 80% of the cost =
\$9.60

1% of the cost = \$.12
100% of the cost =

$$\$12.00$$

Check: $.80 \times \$12 =$
\$9.60

To find a number when a per cent of it is given, change the per cent to a decimal and divide the number by this decimal.

Make up a rule for Method II.

Find the missing values in the following:

2. $30 = 10\%$ of ?

7. 20 is 5% of ?

3. $5 = 5\%$ of ?

8. \$6 is 3% of ?

4. $100 = 20\%$ of ?

9. \$8 is 4% of ?

5. $24 = 12\%$ of ?

10. 2% of ? is 10

6. $16 = 4\%$ of ?

11. 15% of ? is 45

EVERYDAY USES OF PERCENTAGE

1. A boy earned \$8 by selling subscriptions to magazines. If he received 40% of the price of the magazines for his work, how much money did he take in?
2. A man wishes to have at retirement, age 65, a yearly income of \$1200 from money invested at 4%. How much money must he invest to provide that income?
3. In a college football game, the home team received 60% of the gate receipts. If the home team's share was \$21,600, what were the total receipts?
4. "50% alcohol is enough anti-freeze protection for your car," said the gas-station attendant to Mr. Long. "Put in 75% and be safe," replied Long. If the attendant poured 12 quarts of alcohol into the radiator, what was the capacity of the radiator?
5. A newspaper headline stated that 312 of the members of the House of Representatives voted for a certain bill. This was 80% of the members present. How many members were present?
6. Mr. Jones was offered a subscription to a magazine for \$3 a year. This was only 60% of the regular price. What was the regular price?
7. A newspaper headline stated that 30% of the people who graduated from a local high school in June went to college. If 36 members of the class went to college, what was the total number of graduates?
- *8. In a recent year 153,468 automobile accidents occurred on Sundays. This represented 17.4% of the total number of automobile accidents for that year. How many occurred during the entire year?
- *9. At a rate of $\frac{1}{2}\%$, the charge for collecting a bill was \$3.20. What was the amount of the bill?



COST OF OPERATING AN AUTOMOBILE

Mr. Bailey read in his daily paper that the cost of operating an automobile is about 6¢ a mile. The various items which make up this cost were also given.

	CENTS A MILE	PER CENT OF TOTAL COST
a. Gasoline.....	1.31	21.83
b. Oil.....	0.22	?
c. Tires and tubes.....	0.64	?
d. Maintenance.....	1.72	?
e. Depreciation.....	1.39	?
f. License and insurance.....	0.36	?
g. Interest.....	0.36	?
Total.....	<u>?</u>	<u>?</u>

1. Find the total cost of operating the car.
2. Find the per cent (to the nearest tenth) each item was of the total cost.

3. What do these items in the table mean:
 a. Maintenance? b. Depreciation? c. License and insurance? d. Interest?

4. No charge was included for garage rental. If that item were included, how would it affect the cost a mile? the per cent of the total cost for each item?

5. If the average motorist drives about 8400 miles a year, what is the yearly cost of operating his car (see problem 1)?

6. How much could Mr. Average Motorist (problem 5) save a year by using a bus at an average cost of 2.2¢ a mile?

7. If Mr. Average Motorist had a family of 5 people to transport, would it be cheaper for his family to travel by bus or by private car? How much cheaper a mile?

8. The average life of an automobile is 7 years. If a new car costs \$1000 and is traded in every year, how much must the owner pay at each trade (see table)?

IF TRADE-IN IS MADE	1ST YR. INITIAL COST	2ND YR. COST	3RD YR. COST	4TH YR. COST	5TH YR. COST	6TH YR. COST	7TH YR. COST
Every year	\$1000	\$250	\$250	\$250	\$250	\$250	\$250
Every 2 yr.	\$1000		\$465		\$465		\$465
Every 3 yr.	\$1000			\$640			\$640

9. If car is traded every 2 years, what does owner pay at each trade? if traded every 3 years? every 7 years?

10. Find the total cost to the car owner for a yearly trade; for a trade every 2 years; every 3 years.

*11. Find the average yearly cost for each kind of trade-in. Decide if it is cheaper to trade in a car every year, every second year, or every third year.

*MORE THAN ENOUGH

1. The principal of the Park School said that his enrollment was 750, or 20% more than the building was planned to accommodate. How many pupils was the building planned to accommodate?

Since the building is accommodating 20% more than was planned, it must be accommodating 120% of the number planned. $120\% = 1.20$

Then, $1.20 \times$ the number planned = 750.

$$1.20 \times ? = 750$$

If the product and one of two numbers are given, the missing number is found by dividing the product by the known number. $750 \div 1.20 = 625$

The building was planned for 625 pupils.

Check: $1.20 \times 625 = 750$.

Find a number when:

a

b

2. 20% more than it is 72	20% less than it is 120
3. $33\frac{1}{3}\%$ more than it is 240	25% less than it is 450
4. 15% less than it is 34	10% more than it is 385
5. 150% more than it is 125	30% less than it is 630
6. In a recent year the number of deaths caused by automobile accidents increased 10%. If there were 36,300 deaths due to automobile accidents in that year, what was the number the previous year?	
7. A man said, "My living expenses have increased 50% within the past five years and I am now spending \$45 a week to support my family." How much was he spending five years ago?	

ORDERING FROM A CATALOG

1. Mr. Baker, athletic director of Valley View High School, orders equipment from a sporting goods catalog.

First-quality baseball uniforms are priced in the catalog at \$24, with 20% off to schools. What does Mr. Baker pay for each uniform?

$$20\% = .20 = .2 \quad .2 \times \$24 = \$4.80 \\ \$24 - \$4.80 = \$19.20$$

- a. What do you call the price, \$24, as listed in the catalog?
- b. What do you call the amount, \$4.80, deducted from the list price?
- c. What do you call the list price less the discount (\$19.20)?

Find the net price of the following:

LIST PRICE	DISCOUNT	LIST PRICE	DISCOUNT
2. \$350	8%	5. \$95	24%
3. \$625	28%	6. \$105	$33\frac{1}{3}\%$
4. \$721	35%	7. \$450	16%

8. The list price of an automobile at the factory is \$745. If the dealer is allowed a discount of 24%, find the net cost of the car to the dealer.

9. Find the net cost of tennis balls, listed at 40¢ each, discount $37\frac{1}{2}\%$.

10. A table, listed in a catalog at \$37.50, cost the dealer \$22.50. What rate of discount was allowed?

11. Mr. Baker ordered athletic equipment listed at \$720. He paid \$540. What rate of discount was he allowed?

*12. An automobile is marked to sell for x dollars, but a trade discount of r per cent is allowed. What is the amount of the discount? What is the net cost of the car?

SUCCESSIVE DISCOUNTS

A buyer may be allowed two or more discounts. He may be given an ordinary trade discount, a second discount for prompt payment, and a third discount for any one of several reasons, such as an unusually large order.

1. The list price of a radio was \$120. The dealer, however, allowed a discount of 20% to a school and a second discount of 5% for cash. What was the net cost of the radio?

$20\% = .20$; $5\% = .05$; list price = \$120.

$.20 \times \$120 = \24 , amount of first discount.

$\$120 - \$24 = \$96$, price after deducting the 20% discount.

$.05 \times \$96 = \4.80 , amount of second discount.

$\$96 - \$4.80 = \$91.20$, price after deducting the second discount. The net price of the radio was \$91.20.

To find the net price when two successive discounts are given, find the net price after either discount has been taken. Use this net price and repeat the process with the other discount.

Find the net price:

LIST	DISCOUNTS	LIST	DISCOUNTS
2. \$600	20%, 10%	5. \$48.50	10%, 2%
3. \$480	20%, 12½%	6. \$3800	25%, 10%
4. \$90	10%, 5%	7. \$37.50	33⅓%, 2%
8. Mr. Wells bought goods amounting to \$360 at discounts of 25% and 10%. Find the net cost of the goods.			
9. Using the figures in problem 8, find the discount at 10% first; then the discount at 25%. Does the order in which the discounts are taken make any difference?			

BUDGETING AN INCOME

The Jones family has an income of \$2000 a year. People who know a great deal about family budgets say that the Jones' should spend their income about as follows:

Living	52%	Clothing	12%
Food.....	25%	Miscellaneous.....	11%

1. What per cent of income is allotted to each item?
2. How much money is allotted to each item?
3. A savings bank suggests budgets for families with incomes as given in the table. What is the yearly income of each family?

Budget Items	\$25 wk.	\$30 wk.	\$40 wk.	\$50 wk.	\$60 wk.	\$80 wk.	\$100 wk.
Food.....	\$8.00	\$9.00	\$10.00	\$12.00	\$13.00	\$15.00	\$17.00
Clothing.....	2.50	3.00	4.00	5.00	6.00	8.00	10.00
Shelter.....	6.00	7.00	10.00	12.00	15.00	20.00	22.50
Operating expenses.....	2.50	3.00	4.50	5.50	6.50	9.00	11.00
Health — recreation ...	1.50	2.00	3.00	4.00	5.00	8.00	10.50
Automobile...	1.00	1.50	2.50	3.00	3.50	6.00	8.00
Savings.....	1.25	1.50	2.00	3.00	3.50	4.50	6.00
Insurance.....	1.25	1.50	2.00	2.50	3.50	4.50	6.00
Miscellaneous.	1.00	1.50	2.00	3.00	4.00	5.00	9.00
Total.....	\$25.00	\$30.00	\$40.00	\$50.00	\$60.00	\$80.00	\$100.00

4. What per cent of income may wisely be spent:
 - a. for food by a \$50 a week family?
 - b. for clothing by a \$30 a week family?
 - c. for shelter by a \$60 a week family?
 - d. for operating expenses by an \$80 a week family?
 - e. for recreation by a \$25 a week family?
 - f. for insurance by a \$40 a week family?
5. What per cent of income should be saved by each family group represented in the suggested budgets?

ECONOMICAL BUYING

Buying in quantities is sometimes more economical than in small lots.

1. What per cent may be saved by buying soap at 3 cakes for 25¢ instead of three cakes at 10¢ a cake?

$3 \times 10\text{¢} = 30\text{¢}$, the cost of 3 cakes at 10¢ each.

$30\text{¢} - 25\text{¢} = 5\text{¢}$, amount saved by buying in quantity.

$5\text{¢} \div 30\text{¢} = .16\frac{2}{3} = 16\frac{2}{3}\%$, the per cent saved.

To find the per cent saved by buying in quantities, divide the difference between the two costs by the greater cost.

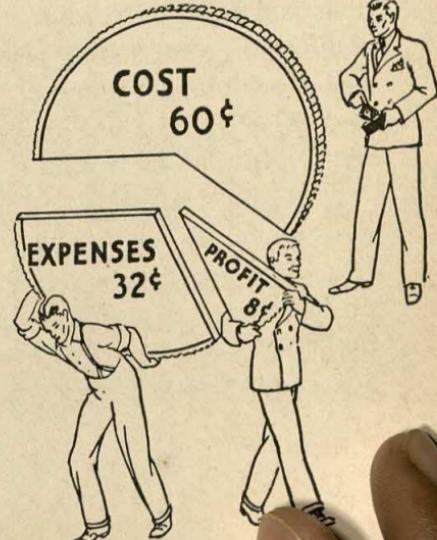
2. A round-trip railroad ticket between two places costs 55¢, a one-way ticket 35¢. What per cent is saved by buying a round-trip ticket instead of 2 one-way tickets?
3. Potatoes are sold in 100-pound bags at \$1.15, or 21¢ a peck. What per cent may be saved by buying in quantities of 100 pounds instead of by the peck? (1 peck = 15 lb.)
4. A dealer sells coal at \$10.50 a ton with 50¢ off for cash if the bill is paid within 10 days. What per cent off is allowed for prompt payments?
5. At a "special sale," 3 neckties were sold for \$2. If the regular price of each necktie was \$1, what per cent was saved by buying three at a time?
6. Tennis balls sell at 35¢ each, or \$3.75 a dozen. Henry uses about a dozen tennis balls during the season. What per cent can he save by buying by the dozen?
7. Kathryn and Marion live near the city. Kathryn bought a 50-trip bus ticket for \$8.50 and Marion bought a 10-trip ticket for \$2.20. If each girl makes 50 trips to the city, what per cent is Kathryn saving?

MARGIN, EXPENSE, PROFIT

"You see that box of crackers?" said a grocer to one of his customers. "They cost me 12¢ a pound. I sell them for 18¢ a pound and lose money on every pound." John overheard the conversation and asked the grocer to explain. "Selling price," continued the grocer, "must cover the cost of an article plus my **margin**. Out of the margin I pay such expenses as taxes, rent, heat, light, advertising, and wages, and usually have some money left for profit. These crackers, however, are too expensive to handle. They break so easily! I have no profit."

Each dollar which the grocer or any other merchant receives from the sale of merchandise is called the **sales dollar**. A shoe dealer divided his sales dollar as shown at the bottom of the page.

1. What per cent of the dollar is cost? profit? expense? margin?
2. If a fur coat sold for \$225 and the cost was \$110, what was the margin?
3. A sweater, which cost \$6, was disposed of at a sale for \$4. What was the per cent loss on the sweater?
4. A rug, which cost \$40, was sold for \$55. If the expenses were \$20, was there a profit or loss? how much?
- *5. If cost plus margin equals selling price, is there a gain or loss?
- *6. If cost and margin are equal, the selling price is how many times the cost?



BUYING AND SELLING MERCHANDISE

Find the missing values in the following:

COST	MARGIN	EXPENSES	PROFIT	LOSS	SELLING PRICE
1. \$24.25	?	\$6.25	\$4.50	-	?
2. \$2.60	\$0.90	\$0.55	?	-	?
3. \$5.75	\$2.40	\$3.05	-	?	?
4. \$0.87	?	?	\$0.27	-	\$1.50
5. \$89.75	\$60.25	\$30.75	?	-	?
6. ?	\$2.35	?	\$0.75	-	\$7.80
7. \$12.40	?	\$3.55	-	?	\$12.95

8. A table which cost \$16 was sold for \$28. If the expenses of selling were \$7, what was the profit?

9. A car was sold at a margin of \$90, but the expenses of selling were \$40. What was the profit?

10. Mr. White sold a house for \$3500 which had cost him \$3750. What was his loss?

11. Mr. Cook said that he could not operate his business on less than a 25% margin. If his expenses are 14% of his sales, what per cent is profit? What is his profit on an article that sells for \$17.50?

*12. Using s for selling price, c for cost, and m for margin, write formulas for s and c .

*13. Using m for margin, e for expenses, and p for profit, write formulas for m and e .

*14. Using l for loss, c for cost, and s for selling price, write formulas for c and s .

*15. If s represents selling price; c , cost; m , margin; p , profit; e , expenses; and l , loss, which of the following formulas are correct: a. $c = s - e$; b. $l = s - c$; c. $m = s - c$; d. $e = m - c$; e. $p = m - e$; f. $s = c + m$.

USING THE VOCABULARY OF ARITHMETIC

Below are terms used in this chapter. State what each term means, or use it correctly in a sentence. If you do not know the meaning, turn to the key page in parentheses.

budget	(81)	per cent	(59)
sales dollar	(83)	profit	(83)
discount	(79)	selling price	(83)
margin	(83)	successive discounts	(80)
net price	(79)	trade discount	(80)

REVIEW OF PER CENT

Set I

Find the missing numbers without the use of pencil.

1. 10% of 60 = ?	9. 25% of 200 = ?
2. 150% of 20 = ?	10. 1% of 500 = ?
3. 50% of 600 = ?	11. $33\frac{1}{3}\%$ of 90 = ?
4. 20 = ? % of 40	12. 10 = ? % of 50
5. 60 = ? % of 30	13. 17 = ? % of 100
6. 8 = ? % of 32	14. 9 = ? % of 27
7. 12 = 25% of ?	15. 16 = 10% of ?
8. 14 = 50% of ?	16. 5 = 1% of ?

Set II

Use pencil to find the missing numbers.

1. 14% of 72 = ?	9. 36% of 125 = ?
2. 210% of 55 = ?	10. 16.5% of 320 = ?
3. $\frac{1}{2}\%$ of 450 = ?	11. 4.5% of 175 = ?
4. 9 = ? % of 14	12. 12 = ? % of 7
5. 27 = ? % of 135	13. 81 = ? % of 45
6. 360 = ? % of 400	14. 24 = ? % of 90
7. 15 = 30% of ?	15. 18 = 90% of ?
8. 32 = 16% of ?	16. 120 = 12% of ?



HOW WELL DO YOU REMEMBER?



1. Write as per cents: *a.* .1; *b.* .03; *c.* 1.04; *d.* $\frac{1}{2}$; *e.* 2; *f.* .005; *g.* $\frac{3}{4}$; *h.* 2.5.
2. Express as decimals or whole numbers: *a.* 40%; *b.* $1\frac{1}{2}\%$; *c.* 2%; *d.* $\frac{1}{2}\%$; *e.* 104%; *f.* 100%.
3. Write as fractions: *a.* 20%; *b.* $33\frac{1}{3}\%$; *c.* 75%; *d.* $12\frac{1}{2}\%$; *e.* 50%; *f.* $66\frac{2}{3}\%$; *g.* 80%.
4. On a spelling test of 25 words, Sarah made a score of 92%. How many words did she misspell?
5. An automobile dealer received a discount of 24% on the price of new cars. How much does he pay for a car which is marked to sell at \$795?
6. An agent sold automobile accessories on a commission of 40%. If his sales amounted to \$96 in one week, what was his commission?
7. Over a period of 10 years the average price of electric refrigerators dropped from \$220 to \$140. What was the per cent reduction?
8. Mr. Bell earned \$30 one week working on a commission of 20% of his sales. What was the amount of his sales for the week?
9. A kitchen sink is listed in a catalog at \$80. Find the net cost to a plumber if he is given discounts of 40% and 10%.
10. A merchant marked a suit that cost him \$15 at 50% above cost. What was his margin?
11. A pair of shoes, costing \$3, was sold for \$5. What was the profit, if expenses were 15% of the sales price?
12. Chewing gum sells at 5¢ a package or 3 packages for 10¢. What per cent of the cost of single packages may be saved by buying in quantities of three?
13. If 40% of a number is 72, what is the number?

THINGS TO REMEMBER

1. How to change a decimal to a per cent and a per cent to a decimal.
2. How to change a fraction to a per cent and a per cent to a fraction.
3. How to find a per cent of a number.
4. How to find what per cent one number is of another.
5. How to find a number when a per cent of it is given.

TEST ON CHAPTER III

1. How is a decimal or a common fraction changed to a per cent? Change the following to per cents: a. .5; b. $\frac{3}{8}$; c. 1.035; d. .004; e. $\frac{3}{5}$; f. 1; g. $1\frac{1}{2}$.
2. How is a per cent changed to a decimal? Change the following per cents to decimals: a. 3%; b. $\frac{1}{2}\%$; c. $1\frac{3}{4}\%$; d. 104%; e. 150%; f. 102.5%.
3. A car is listed at \$745 at the factory, delivered price \$960. What per cent of the factory price is the delivered price (answered to nearest tenth per cent)?
4. If a dealer sold the car (problem 3) at the delivered price, commission for selling 24%, what was his commission?
5. Find the net cost of a shipment of goods, marked \$650, when discounts of 20% and 5% are allowed.
6. The subscription price of a magazine is \$2 a year, \$3.50 for two years, \$5 for three years. What per cent of the yearly rate is saved by a two-year subscription? a three-year subscription?
7. A suggested budget for a family income of \$1200 is as follows: Food, 35%; rent, 25%; clothing, 8%; house operation, 7%; savings, 8%; miscellaneous, 17%. Find the amount of each item in the budget.

*INFORMATION PLEASE!

1. List twenty ways in which per cent is used. Classify each use under one of the three kinds of per cent examples about which you studied in this chapter.
2. How does a merchant determine whether or not his advertising pays?
3. Certain manufacturers sell direct to the consumer (person who uses the goods), not through middlemen (wholesale or retail dealers). What does this mean? List 5 products sold direct; 5 through middlemen. Which method of selling is more common? Why?
4. Give illustrations to show that the amount earned working on commission depends upon: (a) the rate of commission; (b) the rate of commission and the selling price of an article; (c) the rate of commission, the selling price of an article, and the number of articles sold.
5. The amount of "mark-up" is an important item in the number and the size of discounts which a merchant may give. Show why this is true.

A MAGIC SQUARE

On the right is a magic square with some of the cells vacant. Construct a square containing 36 cells, copy the numbers given, and supply those which are missing.

?	37	42	62	55	60
39	?	43	57	?	61
67	45	?	58	63	?
?	64	69	53	46	51
66	41	70	48	50	52
40	72	65	?	54	?

PROGRESS TEST

If you make errors on this test, turn to the key pages in parentheses where the work is explained.

1. $5\frac{3}{4} - 1\frac{5}{8} = ?$ (14)
2. $\frac{7}{8} \div 4\frac{1}{4} = ?$ (18)
3. $7000 - 5008 = ?$ (8)
4. $8\frac{1}{2} \times \frac{5}{6} = ?$ (16)
5. $1.4 \times 3.8 = ?$ (21)
6. $9768 \div 47 = ?$ (12)
7. $5.7456 \div 1.68 = ?$ (25)
8. $3\frac{1}{4} \times 8\frac{3}{4} = ?$ (16)
9. $9\frac{3}{8} + 6\frac{1}{2} + 7\frac{3}{4} + 2\frac{7}{16} + 4\frac{5}{8} = ?$ (14)
10. $3.542 + 0.915 + 0.050 + 1.465 + 2.449 = ?$ (20)
11. Round off the following to the nearest hundredth: a. .458; b. .1349; c. .995; d. .6975. (27)
12. If $\frac{7}{8}$ of a yard of cloth costs 84¢, what is the cost of one yard? (73)
13. Find the area of a triangle having a base of 19 inches and an altitude of 15 inches. (40)
14. If a circle has a diameter of 14 feet, what is its area? (Use $\pi = \frac{22}{7}$) (50)
15. Prove that there are 144 square inches in one square foot. (38)
16. What is the difference between an equilateral triangle and an isosceles triangle? Draw each. (42)
17. If a bicycle wheel is 28 inches in diameter, how far will it move in one revolution? (Use $\pi = \frac{22}{7}$) (48)
18. In a class of 36 pupils there are 20 girls. What per cent is girls? (66)
19. How much is 5% of \$675? (65)
- *20. If 4% of a number is 72, what is the number? (74)

SPEED

1938 224 MILES PER HOUR



1941 295 MILES PER HOUR

RANGE

1938 2,375 MILES

1941 3,255 MILES

CEILING

1938
25,700 FEET

1941
29,070 FEET



GROSS WEIGHT

5 TONS 5 TONS 5 TONS

1938 26,000 POUNDS

5 TONS 5 TONS 5 TONS 5 TONS 5 TONS

1941 47,698 POUNDS

Here are four pictographs which tell a thrilling story of America's airplane development. You can see at a moment's glance the increase in airplane speed, range, flying height, and weight. Explain what each pictograph means.

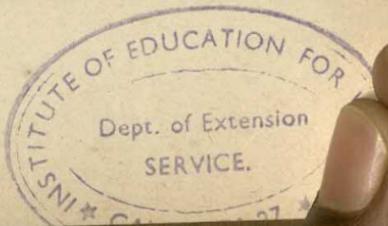
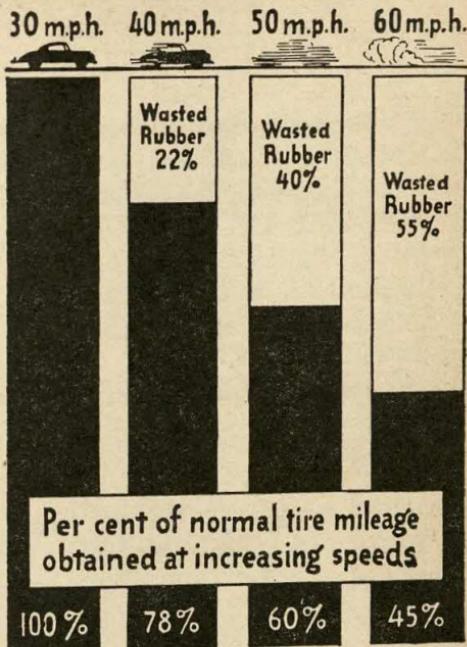
CHAPTER IV

GRAPHS TELL THE STORY

Number facts about things and people can usually be understood more easily in the form of a graph than by a table of figures. You have read and constructed many graphs. Now you will continue your study of this common way of showing the relationship between quantities.

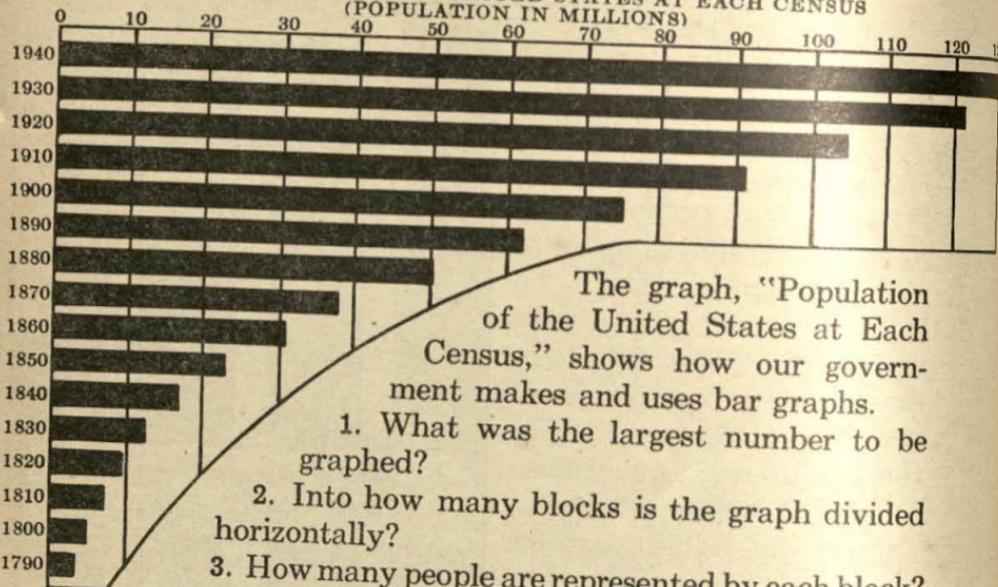
Your father, for example, wants to get the best possible mileage out of his tires. This graph shows one way to do so.

1. At what speed may he drive with ordinary wear on his tires and no waste of rubber?
2. What per cent of rubber will he waste at a speed of 40 miles an hour? 50 miles? 60 miles?
3. The amount of rubber wasted at 60 miles an hour is how many times as much as at 40 miles an hour?
4. "Keep this tire inflated to 35 pounds, drive not over 30 miles an hour, and the tire will last 25,000 miles," said a tire dealer. What would be a safe guarantee on this tire if the speed were 40 miles an hour? 50 miles? 60 miles?
5. At what speed is a driver wasting about half the normal (ordinary) mileage in his tires?
- *6. Estimate from the graph the mileage wasted in tires at a speed of 70 miles an hour.



MORE ABOUT BAR GRAPHS

POPULATION OF THE UNITED STATES AT EACH CENSUS
(POPULATION IN MILLIONS)



The graph, "Population of the United States at Each Census," shows how our government makes and uses bar graphs.

1. What was the largest number to be graphed?
2. Into how many blocks is the graph divided horizontally?
3. How many people are represented by each block?
4. Are the bars equal in width or do they vary in width? the spaces between the bars?
5. Are the spaces between the bars wider or narrower than the bars? Why?
6. Suppose this graph began at 10 million, not zero. Would it be more or less accurate than as shown? Why?
7. Select a scale to be used if the greatest number of spaces on a graph is 10 and the number for each bar is

a. 9	c. 92	e. 890	g. 6745
b. 36	d. 138	f. 943	h. 12,396
8. Show by means of a bar graph the number of telephones to each 100 people in the following countries:

United States.....	16	Australia.....	10
Great Britain.....	7	Union of South Africa	2
Canada.....	12	China.....	.04
Argentina.....	3	New Zealand.....	13

9. Make a bar graph showing the annual average earnings of the following occupations (Labor Statistics, 1940).

Medicine.....	\$4970	Ministry.....	\$1960
Engineering.....	4460	Skilled trades.....	1410
Architecture.....	3790	Nursing.....	1295
Library work.....	1990	Unskilled labor.....	785

10. The average lifetime earnings of the eight groups (problem 9) are as follows. Show these earnings by use of a bar graph.

Medicine.....	\$239,000	Ministry.....	\$87,000
Engineering.....	238,000	Skilled trades.....	62,800
Architecture.....	205,000	Nursing.....	23,000
Library work.....	94,000	Unskilled labor.....	12,900

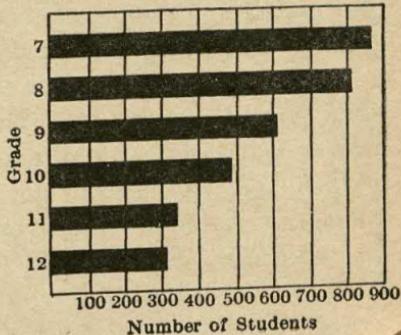
11. Using the data in problems 9 and 10, find the number of years (to the nearest whole number) each group of people works at its trade or profession.

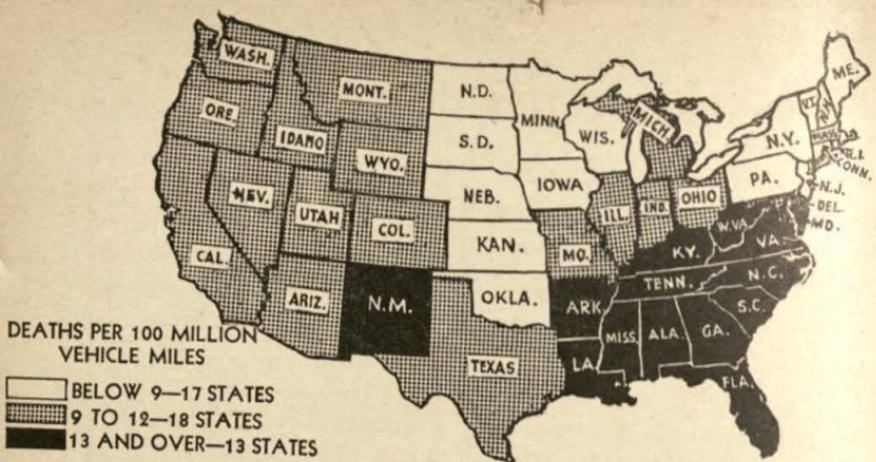
12. The question "How long do pupils remain in school?" was answered by a study of the records of 1,000 boys and girls. The results of the study are shown in the graph. One space or unit on the graph represents how many pupils?

13. About how many pupils remained in school through Grade 7? Grade 8? Grade 9? Grade 10? Grade 11? Grade 12?

*14. Between which two grades was there the greatest per cent "dropping out" of school?

*15. What per cent of the pupils in Grade 7 graduated from high school?





SAFE DRIVING

Sue clipped the map graph from her local newspaper and brought it to class with the remark that she did not believe the number facts as shown on the graph were correct. After you have studied the graph, tell what you think.

1. What is the title of the graph?
2. What three kinds of vehicles must be included in any study of motor-vehicle mileage?
3. What does black indicate on the map? white? the shading?
4. Give the deaths a 100 million vehicle miles in Florida; Maine; Washington; the state in which you live. (If your state is named above, choose New Mexico.)
5. In which part of the country is the number of deaths a 100 million vehicle miles the greatest?
- *6. Would you say from the graph that dense population was or was not the chief cause of fatal accidents? Explain.
- *7. Asked why she did not like the graph, Sue said, "The blocks of states are too even. All the Southeastern States, for example, are 'black'; all the Northeastern States, 'white.'" Tell how you would check the correctness of this graph in order to satisfy Sue.

BROKEN-LINE GRAPHS

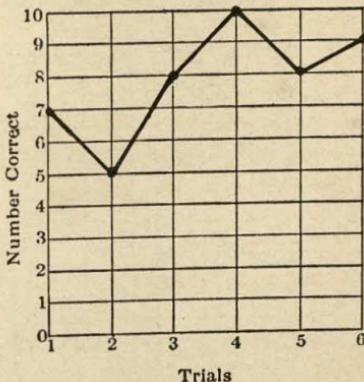
Jim's record of the number of problems solved correctly on six different arithmetic tests is given in the following table, and shown on the graph.

Trial	1	2	3	4	5	6
Correct	7	5	8	10	8	9

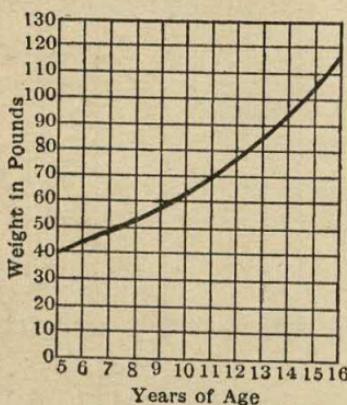
1. On which scale, the vertical or the horizontal, are the "numbers correct" shown? the "trials"?
2. What kind of paper is used, ruled or graph? Could the other kind have been used?
3. What is the largest number to be graphed on the vertical scale? the horizontal?
4. What does each division on the horizontal scale represent? the vertical?
5. Suppose Jim took 100 tests and had 100 examples in each test. What scale divisions would you recommend?
6. How many examples did Jim work correctly in "trial 3"? What two lines cross to fix this point on the graph?
7. The average cost of a bushel of potatoes in January was \$1.20; in March, \$1.68; May, \$1.32; July, \$1.05; September, \$0.91; November, \$0.86. Show these prices by a broken-line graph.
8. A motorist who gets 18 miles to a gallon of fuel at 30 miles an hour, will get about:

16	miles	to a gallon	at 40 miles	an hour
15	"	"	"	" 50 "
13	"	"	"	" 60 "
11	"	"	"	" 70 "

Show this fuel use by a broken-line graph.



CURVED-LINE GRAPHS

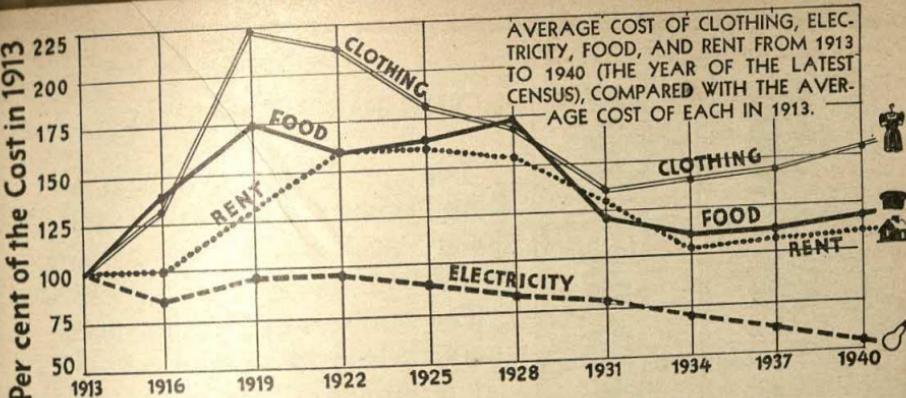


A curved-line graph may be used to show a gradual change from one amount to another; as, for example, the increase in the average weight of boys from ages 5 to 16.

1. About how much should be the weight of a boy 6 years of age? 12 years? 15 years?
2. About what should be the age of a boy who weighs 50 pounds? 75 pounds? 100 pounds?
3. If you double your age, do you double your weight? more or less, and how much?
4. About how much should a boy of 11 years weigh? Which two lines cross to give you this point?
5. Exactly how much should a boy of 8 years weigh? Why cannot this be answered from the graph?
6. Should a boy of 8 years weigh more or less than 50 pounds? Why? More or less than 60 pounds? Why?
7. Would you judge from the graph that a boy of 8 years should weigh 53 pounds? 54 pounds? or 55 pounds?
8. From the ages given on the graph, during which years should a boy gain at least 10 pounds each year?
9. At automobile proving grounds, cars are driven at various speeds, brakes applied, and the stopping distance measured. Show on a curved-line graph the stopping distance for each speed given below.

Miles an hour
Stopping distance (feet)

10	20	30	40	50	60	70
6	22	50	88	138	200	272



UPS AND DOWNS OF LIVING COSTS

1. What needful things which your family buys are shown on this graph?
2. What period of time is covered by the graph?
3. The cost of an article in 1913 is represented on the graph by what per cent?
4. The cost of clothing in 1916 is compared with its cost in what year?
5. The cost of electricity in 1928 is compared with its cost in what year? of rent? of food?
6. Which of the commodities shows the greatest change in cost over the span of years covered by the graph?
7. Would a dollar spent for electricity today purchase more or less current than in 1913? a dollar spent for rent? for food? for clothing?
8. If a suit cost \$20 in 1913, about what did it cost in 1919?
9. During what period did the per cent cost of food rise most sharply? the per cent cost of rent? of clothing?
10. About how much were these increases (problem 9)?
11. When did the greatest per cent decrease in the cost of electricity occur? What was this decrease?
- *12. Name some of the things which made the costs of clothing, food, and rent change so much in price.

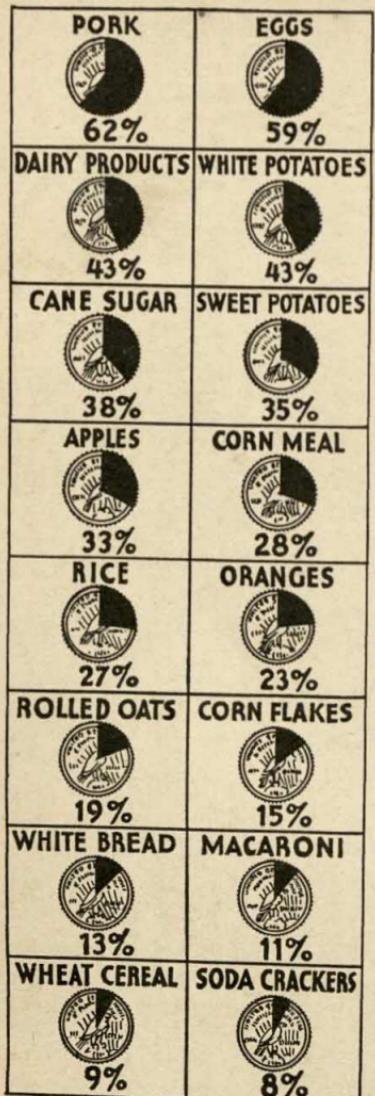


FIG. A.—How to read this circle graph: The farmer who raises hogs to sell receives 62%, or 62¢, of each dollar spent for pork products by consumers.

THE FARMER'S SHARE

You spend \$1 for food at a store. How much of that "food dollar" goes to the farmer who produced the food?

The answer for certain food products is given in Figure A.

1. Figure A is a circle graph. Why is it so called? Sometimes this form of graph is called a "pie graph." Why?

2. The farmer receives at least half the food dollar for what foods shown on the graph? at least one fourth the food dollar for what foods?

3. The farmer receives what per cent of the food dollar for oranges? for apples? for white bread?

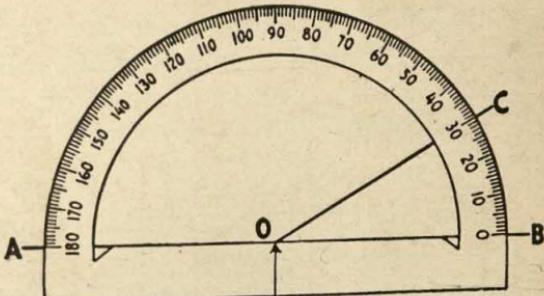
*4. Why does the farmer receive such a small percentage of the food dollar for wheat cereal?

*5. Name some of the things, other than the farmer's share, which help to add to the cost of a food product.

*6. The farmer's share of the food dollar changes from year to year. What are some of the things which produce this change?

HOW TO CONSTRUCT CIRCLE GRAPHS

You should know how to construct as well as how to read (page 98) circle graphs. To do this job accurately, you must test your skill in using a protractor to draw an angle of any given size.



1. Suppose your problem is to draw an angle of 30° to line AB . Where would you place the straight edge of the protractor?
2. Where would you place the center point of the protractor?
3. What two points would you connect to form the 30° angle BOC ?
4. Use your protractor to draw an angle of: a. 45° ; b. 165° ; c. 38° ; d. 115° ; e. 72° ; f. 143° .
5. To construct a circle graph, proceed as follows:
 - a. If the numbers given are not expressed as per cents, find their sum.
 - b. Find what per cent each number is of the total number to the nearest whole per cent.
 - c. Multiply 360 degrees by each per cent found in b. Each product represents the number of degrees in each angle to be drawn at the center of the circle.
 - d. Draw a circle with any convenient radius. With the use of a protractor, draw the angles at the center which you found in c.
 - e. Seldom should more than six items be represented on a circle graph.

CONSTRUCTING CIRCLE GRAPHS

Construct circle graphs from the following data:

1. A merchant said that the selling price of each article sold in his store was made up of: cost, 65%; expense, 30%; profit, 5%.
2. The clothing worn by people in this country is made from the following textiles: cotton, 83%; wool, 8%; silk and linen, 2%; rayon, 7%.
3. For each dollar of tax money spent in one of our states, municipal governments spent 34.9¢; county governments, 14.9¢; state governments, 19.7¢; and schools, 30.5¢.
4. There are about 1,050,000 teachers in the United States. 700,000 of these are in elementary schools, 260,000 in secondary schools, and 90,000 in colleges.
5. A budget plan for a family of three, yearly income of \$1800, calls for the following amounts: savings, \$240; food, \$540; clothing, \$240; housekeeping expenses, \$150; rent, \$240; education, recreation, and charities, \$240; miscellaneous, \$150.
- *6. The gainfully employed of Asia spend 90% of their earnings for food and 10% for the comforts of life; those of Europe spend 80% for food and 20% for the comforts of life; those of the United States, 30% for food and 70% for the comforts of life. Draw three circles of equal size, one for each continent or country. Show these relationships by use of circle graphs.
- *7. What conclusion do you draw from the graphs in problem 6 about the standard of living in Asia and Europe compared with that in the United States?



HOW WELL DO YOU REMEMBER?



1. Name four kinds of graphs. Of these four, which is the easiest to read? the most difficult to construct? Why?
2. What is meant by the scale of a graph?
3. If age and weight are represented on a line graph, which should be shown along the vertical scale?
4. The average yearly earnings for certain occupations are given below. Show these earnings by a bar graph.

Dentistry	\$4230	School teaching ..	\$1335
College teaching..	3020	Office typing	1070
Social work	1680	Farm labor.....	475

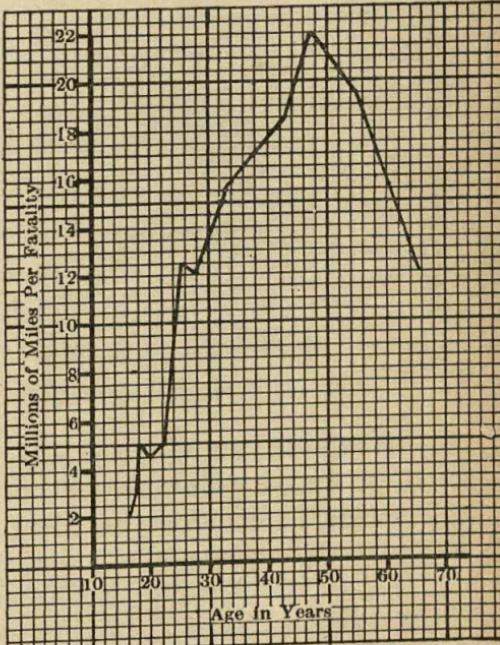
5. "Who have the most fatal (causing death) automobile accidents: young people, middle-aged, or old people?" This question is answered in the graph.

a. How many different age groups are shown on the graph?

b. In which age group is the number of millions of miles traveled the greatest for each fatal accident? the smallest?

c. Persons 20 years of age have one fatal accident to about how many million miles of driving? persons 30 years of age? 40? 50? 60?

d. According to the graph, who is the safest driver: the youth? the middle-aged person? the aged person?

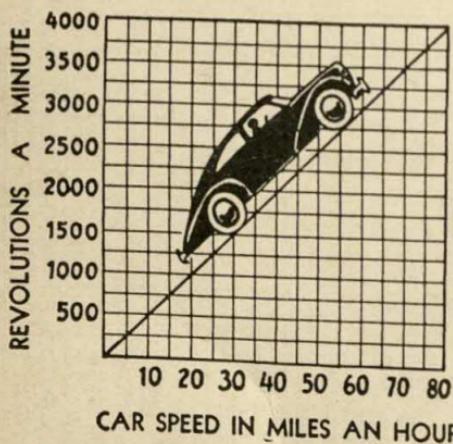


THINGS TO REMEMBER

1. How to read pictographs.
2. How to read, to make, and to find an appropriate scale for bar graphs, line graphs, and circle graphs.

TEST ON CHAPTER IV

1. If you wished to show temperature during certain hours of a day, would it be better to use a bar graph or a line graph? Why?
2. If a bar graph is not to have more than 12 units, what unit would you use when the largest number to be graphed is: a. 10? b. 109? c. 218? d. 1765?

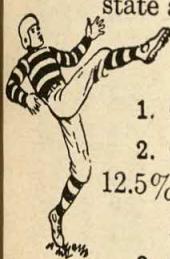


what is the speed of the car?

4. In a recent year, 59% of deaths resulting from motor accidents occurred at night and 41% during daylight. Show these amounts by a circle graph.
5. If there were 32,100 deaths resulting from motor accidents during the above year, how many occurred at night? during daylight?

*TOPICS FOR SPECIAL REPORTS

1. If the scale of a bar or line graph does not begin at zero, the graph usually does not show the facts correctly. Why is this true?
2. A man is earning three times as much today as he did 10 years ago. This fact is shown by two coins, one coin three times the diameter of the other. Why is this graph incorrect?
3. Bring to class different kinds of graphs from newspapers or magazines and show why they are or are not well constructed.
4. Find the value of the four most valuable crops grown in your state and represent these facts by a graph.
5. Find the population of the four largest cities in your state and represent these facts by a graph.



LET'S PRACTICE PERCENTAGE

4

1. Change to per cents: *a.* .7; *b.* 1.4; *c.* 3; *d.* $\frac{1}{2}$; *e.* 1.03.
2. Change to decimals: *a.* 12%; *b.* 105%; *c.* 3%; *d.* 12.5%; *e.* 2.5%; *f.* 180%.

Find the missing numbers in the following:

3. 6% of 75 = ? 9. 125% of 350 = ?

4. $\frac{1}{2}\%$ of 920 = ? 10. 300% of 28 = ?

5. 14 = ? % of 56 11. 72 = ? % of 18

6. 40 = 5% of ? *12. 64 = 16% of ?

7. 147 = ? % of 147 *13. 45 = 150% of ?

8. $\frac{1}{2}\%$ of 340 = ? 14. $\frac{1}{2}$ = ? % of 1

15. Fifty per cent more than 38 is (?).

16. Forty per cent less than 50 is (?).

17. What per cent less than 50 is 30 (?).

PROGRESS TEST

If you make errors on this test, turn to the key pages shown in parentheses where the work is explained.

1. $9\frac{3}{4} + \frac{5}{8} + 8\frac{1}{2} = ?$ (14)
2. $.938 + .045 + .506 + .325 = ?$ (20)
3. $151.776 \div 3.72 = ?$ (22)
4. 17.5% of 350 = ? (65) 5. $11 = ? \%$ of 25 (66)
6. $18 = \frac{3}{4}$ of ? (73) 7. $5\frac{3}{5} \div 1\frac{2}{5} = ?$ (18)
8. $7\frac{1}{2} \times 5\frac{3}{4} = ?$ (16) 9. $10,000 - 1486 = ?$ (8)
10. $\frac{1}{2}\%$ of 550 = ? (72)
11. 16 = 4% of ? (74)
12. $140 = ? \%$ of 35 (66)
13. Round off the following to the nearest tenth:
a. .449; b. 5.95; c. 1.945; d. .055; e. 1.045. (27)
14. A rectangular floor is 21 feet long and 14 feet wide. If a rug $16\frac{1}{2}$ feet long and 12 feet wide is placed on the floor, how much floor space is not covered by the rug? (37)
15. When the price of a dozen oranges decreases from 25¢ to 21¢, what is the per cent decrease?
16. Express as per cents: a. $\frac{3}{4}$; b. $\frac{5}{6}$; c. .025; d. $7\frac{5}{8}$; e. 1.7; f. 1.025; g. $1\frac{1}{2}$; h. $\frac{2}{3}$. (59)
(61)
17. A merchant bought a table for \$24. He marked it 50% above cost and then sold it at a discount of 20% of the marked price. What was his margin? (84)
18. If the population of a city doubles, what is the per cent increase? (69)
19. If two discounts of 10% and 10% are given on a typewriter, marked at \$115, what is the net price? (80)
20. Mr. Wills earned \$26 a week selling brushes. His commission was 40%. What were his weekly sales? (74)



CHAPTER V

RENTING MONEY

1. Frank Scott wanted an automobile to drive his family to the seashore, a distance of 140 miles there and back. He telephoned a rent-a-car agency for rates.

"First 40 miles, 15¢ a mile; 7¢ a mile thereafter plus a 50¢ service fee," answered the agency. What rental did Frank pay for the shore trip?

2. Mr. Scott, Frank's father, had a shoe store. He was ordering his fall and winter stock of overshoes.

"Your bill," said the rubber goods dealer, "comes to \$300; but we can let you have 5% off for cash." What was the cash price of the overshoes?

3. Mr. Scott needed \$200, over and above his cash on hand, to pay for the overshoes. He asked his bank for a loan.

"We charge 6%," said the banker, "6% a year." How much would the loan cost Mr. Scott a year? a month? three months? six months?

4. a. What do you call the charge which Frank paid to the rent-a-car agency for the use of its automobile?

b. The charge which Mr. Scott paid to the bank for use of its money?

c. What is interest?

5. "Loans up to \$300 at 2% a month," advertised a small-loan association. What did the advertisement mean?

6. Interest at 6% a year is the same as what rate for 6 months? for 3 months? for 1 month?



PRINCIPAL—INTEREST—TIME—AMOUNT

1.
 - a. Harry Miller borrowed \$150 from his father to buy a used car. He agreed to pay 5% interest for the use of the money. How much interest a year must he pay?
 - b. What do you call the \$150 which Mr. Miller loaned and Harry borrowed?
 - c. The "5%"?
 - d. The "one year"?
 - e. Using these three terms, write the rule for finding interest.
 - f. $I = prt$. What formula is this? What does the formula mean?
 - g. Find i when $p = \$250$; $r = 4\%$; $t = 2$ years.
 - h. If Harry paid interest on his loan every 6 months, how much would each payment be?
 - i. How much if he paid every 2 years?
2. At the end of the year Harry paid his father \$157.50. How much of this was principal? How much was interest? Principal plus interest equals the amount of the loan.
3. Using i for interest, p for principal, and a for amount, write the formula for the amount.
4. Find the amount of a loan of \$350 at 5% for 6 months.
5. Find the interest and amount:

PRINCIPAL	RATE	TIME	PRINCIPAL	RATE	TIME
a. \$400	5%	6 mo.	d. \$600	6%	1 mo.
b. \$750	4%	1 yr.	e. \$200	$4\frac{1}{2}\%$	4 mo.
c. \$575	5%	1 yr.	f. \$250	$4\frac{1}{2}\%$	6 mo.

6. The interest on a loan of \$1000 for one year was \$55. What was the rate? (THINK: $\$55 = ? \%$ of \$1000.)

SIMPLE INTEREST AND EXACT INTEREST

1. a. Mr. Carr borrowed \$300 at 6% for 75 days. What was the interest on the loan? Copy and complete the work.

$$p = \$300$$

$$r = 6\% \text{ or } \frac{6}{100}$$

$$t = 75 \text{ days or } \frac{75}{360} \text{ year}$$

$$i = \$300 \times \frac{6}{100} \times \frac{75}{360} = ?$$

b. How many days are in a year? a leap year?

c. In problem a a year is considered to have how many days? This is common business usage.

d. The United States Government uses 365 days (leap year, 366) in figuring interest. This method is called exact interest.

e. Work problem 1a by exact interest.

2. When a 360-day year is used in figuring interest, what part of the year is 60 days?

3. When a 365-day year is used in figuring interest, what part of the year is 60 days?

Find the interest, to the nearest cent, on the following: (360 da. = 1 yr.)

	PRINCIPAL	TIME	RATE		PRINCIPAL	TIME	RATE
4.	\$200	60 da.	6%	11.	\$375	122 da.	5%
5.	\$450	80 da.	5%	12.	\$480	30 da.	3%
6.	\$800	45 da.	4½%	13.	\$360	90 da.	2%
7.	\$750	45 da.	4½%	14.	\$720	120 da.	2½%
8.	\$350	3 mo.	5½%	15.	\$960	72 da.	4½%
9.	\$425	31 da.	6%	16.	\$500	50 da.	5%
10.	\$150	62 da.	6%	17.	\$100	60 da.	6%

*18. Find the difference between simple and exact interest on \$750 for 90 days at 4%.

FINDING INTEREST RATES

1. "The interest on that loan, Mr. Scott," said his banker, "will be \$12 a year." If Mr. Scott had borrowed \$200, what rate of interest was he paying?

$$i = \$12 \quad p = \$200 \quad r = ? \quad \$12 = ? \% \text{ of } \$200$$

$$\frac{12}{200} = .06 = 6\% \quad \text{Check: } .06 \times \$200 = \$12.$$

The rate of interest is 6%.

2. A letter from a small-loan company read, "We can let you have \$300 at any time, and the cost to you will be only \$7.50 for 3 months. What rate of interest was charged?

"Rate of interest" means the rate for one year.

3 months = $\frac{1}{4}$ year. If the interest for $\frac{1}{4}$ year is \$7.50, the interest for one year is $4 \times \$7.50$, or \$30.

$$\$30 = ? \% \text{ of } \$300 \quad \frac{30}{300} = .1 = 10\%$$

The rate of interest is 10%. Check: $.1 \times \$300 = \30 .

Find the rate of interest on the following:

PRINCIPAL	INTEREST	TIME	PRINCIPAL	INTEREST	TIME
3. \$400	\$24	1 yr.	9. \$500	\$25	1 yr.
4. \$1000	\$55	1 yr.	10. \$90	\$18	1 yr.
5. \$750	\$25	6 mo.	11. \$100	\$8	6 mo.
6. \$1000	\$20	4 mo.	12. \$1200	\$20	3 mo.
7. \$1500	\$50	8 mo.	13. \$600	\$10	3 mo.
8. \$200	\$4	8 mo.	14. \$300	\$3	9 mo.

15. On a loan of \$100 the interest charge was \$1 a month. What was the rate of interest?

16. A small-loan company charges $\frac{3}{4}\%$ a month interest. What is the rate a year?

INSTALMENT BUYING

The price of the refrigerator is \$190; or \$10 down and \$10.55 a month for 18 months.

1. The instalment price is how much more than the cash price?
2. A radio, listed at \$175, can be bought at 15% off for cash; or 20% of the list price down and \$10 a month for 15 months. Find the difference between the cash price and the instalment price.
3. About 60% of all new automobiles are sold on the instalment plan, and the remainder on a cash basis. Show these facts by a circle graph.
4. Clifford gave the following reasons why the instalment price of an article should be more than its cash price. What does each statement mean? Why is it true?
 - a. Extra bookkeeping is required.
 - b. Frequently a collector is needed.
 - c. Some articles have to be reclaimed.
 - d. The merchant makes a loan to the customer and charges interest for the loan.
5. Betty reported to her class some advantages and disadvantages of instalment buying. What is meant by each?
 - a. Instalment buying increases business.
 - b. Instalment buying results in bad habits of thrift.
 - c. Instalment buying enables people to enjoy many comforts of home that would otherwise be denied to them.
 - d. The rate of interest charged is sometimes very high.
- *6. Debate this question in class: Resolved, That instalment buying should be encouraged in this country.



CASH OR ON TIME

In each of the following examples find how much above his cash price a merchant charged for articles sold on instalments.

ARTICLE	CASH PRICE	DOWN PAYMENT	MONTHLY PAYMENT	NUMBER OF PAYMENTS
1. Radio	\$120	\$30	\$10	12
2. Used car	\$385	\$156	\$23	12
3. Suit of clothes	\$25	\$5	\$5	6
4. Set of books	\$22	\$2	\$2	12
5. Washing machine	\$59	\$5	\$5	12
6. Vacuum cleaner	\$50	\$7	\$6	8

7. An electric clock is sold for \$10 cash, or \$2 down and \$1 a month for 9 months.
8. The cash subscription price of a magazine is \$5, or \$1 down and \$1 a month for 5 months.
9. A cedar chest is priced at \$50 cash, or \$5 down and \$5 a month for 10 months.
10. A gas range sells for \$93 cash, or \$10 down and \$10 a month for 10 months.
11. A store advertised a three-piece living room suite for \$90 cash, or a down payment of \$25 and 5 monthly instalments of \$15 each.
12. An automobile finance company offers to make a loan of \$300 for 6 months to be paid in 6 monthly instalments of \$54.40.
13. A radio is marked \$60 cash, or \$5.50 a month for 12 months.
- *14. A small radio sells for \$18 cash, or \$2 down and \$2 a month for 9 months. How much more is the instalment charge than interest on a loan of \$16 at 6% for 9 months?

*INSTALMENT RATES

1. A radio sells for \$29 cash, or \$2.50 down and \$5 a month for 6 months. What rate of interest is equivalent to the additional cost of buying the radio on instalments?

Interest Formula: $i = prt$, therefore $r = \frac{i}{pt}$

$i = \$32.50 - \$29 = \$3.50$, added cost of buying on instalments

$\$32.50 - \2.50 (down payment) = \$30 (balance for one month)

$30.00 - 5.00$ (monthly payment) = 25 (" " " ")

$25.00 - 5.00$ (" ") = 20 (" " " ")

$20.00 - 5.00$ (" ") = 15 (" " " ")

$15.00 - 5.00$ (" ") = 10 (" " " ")

$10.00 - 5.00$ (" ") = 5 (" " " ")

$p = \dots \dots \dots \dots \dots \dots$ \$105 (total of unpaid balances for one month)

$t = 1$ month, or $\frac{1}{12}$ of a year

$$r = \frac{3.50}{105 \times \frac{1}{12}} \times \frac{12}{12} = \frac{42}{105} = \frac{2}{5} = 40\% \text{ (check this work)}$$

a. How much and how often did the unpaid balances decrease? Why?

b. Why does t in the formula equal $\frac{1}{12}$?

c. Why were both numerator and denominator of the fraction multiplied by 12?

d. What rate of interest is equivalent to the added cost of buying the radio on instalments?

2. A vacuum cleaner sells for \$65 cash, or \$5 down and \$8 a month for 8 months. What rate of interest is equivalent to the added cost of buying on instalments?

If $i = \$4$, $p = \$288$, and $t = \frac{1}{12}$, show that $r = 16\frac{2}{3}\%$.

3. Find the interest rate equivalent to the added instalment cost of buying each article listed on page 110.

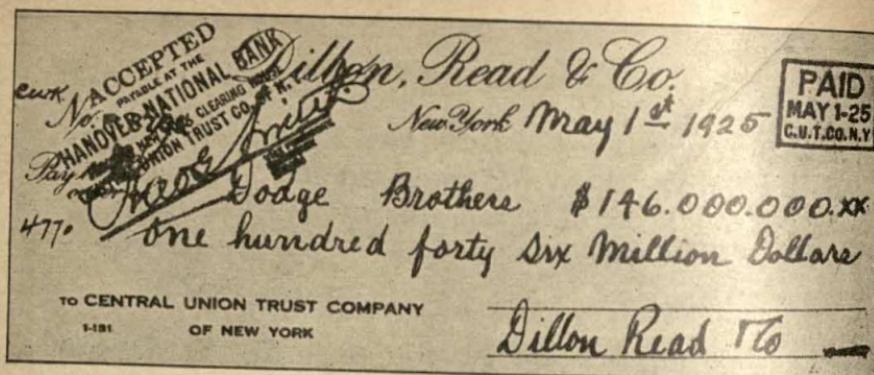


Fig. A. Largest sum ever paid by check to settle a business transaction.

CHECKS—BIG AND LITTLE

John bought a pretzel. He paid **cash**, one cent, for it. His mother bought clothing for the family. She paid the department store bill monthly by **check**. These are two common examples of **business transactions**. Money, or the promise to pay money, was given in each instance; but the amount paid by check was far greater than that paid by cash. Indeed, 92–95% of all money which changes hands in business, is by check.

1. Suppose that sales of goods or services in your community during one week amounted to \$5,000,000. About how much would be paid in cash? by check?
2. An American family, engaged in the manufacture of automobiles, decided to sell its business. A purchaser was found at \$146,000,000 (Fig. A). This was the largest sum ever paid by check to settle a business transaction.
 - a. Who was the **payee** (party to whom money is to be paid) of the check?
 - b. Who was the **maker** (party who must pay the money) of the check?
 - c. On what bank was the check drawn?
 - d. When was it drawn? e. Where was it drawn?

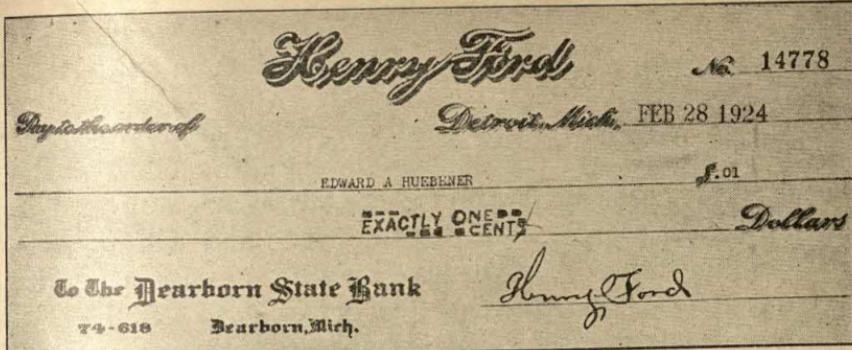


Fig. A. One of the smallest amounts ever paid by check.

- f. What writing must be made on the back of this check before it can be cashed or deposited?
- g. Who must sign this writing?
3. Figure 113-A represents one of the smallest amounts ever paid by check. Apply each question (problem 2) to this check.
4. Copy from the checks:
 - a. The amount written in figures; written in words
 - b. The amount typewritten
 - c. The amount printed by a check-writing machine.
5. Our Government at Washington pays its bills, as does any citizen, and usually by check. Each bill must be O.K.'d as correct, blank checks must be printed, filled in properly, and signed. Canceled checks must be filed. All this costs 21¢, on the average, for each check issued.
If the Government issued 35,736,000 checks in a year, how much did the job cost?
6. A bank had \$9,500,000 in deposits, 15% of which it kept on hand.
 - a. If you were a bank examiner, about how much money would you find in this bank at any given time?
 - b. About how much of the depositors' money would be elsewhere?

*SERVICE CHARGES

Banks, as well as the United States Government (page 113), are put to heavy expense in handling checks. Deposit slips, check books, and other forms are supplied to depositors. Records are kept of deposits and withdrawals. These, and other like expenses, may be met by a **service charge** for carrying checking accounts.

Service charges differ among banks. Here is one method:

Depositors may draw monthly without charge

5 checks on monthly balances up to \$100

10 checks on monthly balances, \$100.01-\$300

15 checks on monthly balances, \$300.01-\$400

20 checks on monthly balances, \$400.01-\$500

Unlimited checks on balances over \$500

Depositors will pay

\$1 monthly on balances up to \$200

5¢ for each check drawn above the free allowance

1. Mr. White's August balance averaged \$250. He drew 12 checks during the month. What was the service charge?

2. During the same month Mr. Snowden's balance averaged but \$125. He also drew 12 checks. What service charge did Mr. Snowden pay?

3. Find the service charge for each of the following:

AVERAGE BALANCE	NO. OF CHECKS	AVERAGE BALANCE	NO. OF CHECKS
a. \$320	18	d. \$210	15
b. \$100	5	e. \$190	14
c. \$600	20	f. \$480	23

4. What service charges, if any, would Mr. White and Mr. Snowden have paid if they banked in your neighborhood?

\$150.00

GRAND RAPIDS, MICHIGAN.

November 7, 194-

On demand I PROMISE TO PAY TO
Henry Miller \$150 $\frac{00}{00}$
One hundred fifty $\frac{00}{00}$ DOLLARS
AT First National Bank, Grand Rapids, Mich.
VALUE RECEIVED, INTEREST AT 5 %. Harry Miller
NO 17 DUE 19

"GIVE ME YOUR NOTE"

When Harry Miller borrowed \$150 (page 106), he gave his father a written promise to repay the money.

1. What do you call this form of promise?
2. Who owes the money and promises to pay? What is he called?
3. To whom must the money be paid? What is he called?
4. When must Harry repay the loan? (A note worded "on demand" is called a **demand note**.)
5. If Harry had agreed to repay the loan in 90 days, how would his note have read? Would this be a time or demand note? Why?
6. For how much is the note written? (This is called the **face of the note**.)
7. When was the note written? Where?
8. What rate of interest did Harry agree to pay?
9. How much interest would be due in a year? 6 months? 3 months? one month?
- *10. Write a demand note supplying all necessary elements. Rewrite the note as a time note—3 months.
- *11. Harry's note might have read "Henry Miller, or order"; or "To the order of Henry Miller." Find the meaning of these terms.



\$600.00

KINGSESSING, OHIO.

October 4, 194-

Ninety days AFTER DATE I PROMISE TO PAY TO
THE ORDER OF The Peoples State Bank \$600.00
Six hundred 00 — DOLLARS
AT The Peoples State Bank

VALUE RECEIVED. INTEREST AT —

NO. 36 DUE Jan 2, 194-

Lloyd Scott

Walter Myers

DISCOUNTING A NOTE

"If I had about \$600," said Myers to his friend, Scott, "I could buy that truck and get practically all the hauling business in this neighborhood."

"Why not ask the bank for a loan?" replied Scott. "Put up that \$500 Government bond you own as security, and I will 'go on your note.' "

So the two friends stepped over to the State Bank where, in short order, Myers secured money for his truck, and the bank took his note and possession of his bond.

1. Answer the following questions about the note:

a. Date?	d. Payee?	g. Date payable?
b. Time?	e. Maker?	*h. Negotiable?
c. Face?	f. Interest-bearing?	

2. If Myers will not or cannot pay his note on January 2, what may the bank do with his bond? (Anything of value pledged as security for a loan is known as **collateral**.)

3. What signature, other than Myers', appears on this note?

*4. Scott is called an **endorser**. What is his liability if Myers does not or will not pay the note?

5. The State Bank deducted 6% of the \$600 loan for the use of its money and gave Myers the remainder. How much did he receive? (This is called the **proceeds**.)

$$i = prt$$

$$p = \$600$$

$$r = 6\% \text{ or } \frac{6}{100}$$

$$t = 90 \text{ days,} \\ \text{or } \frac{1}{4} \text{ year}$$

$$\frac{90}{360} = \frac{1}{4}$$

$$i = \$600 \times \frac{6}{100} \times \frac{1}{4} =$$

$$i = \frac{\$600 \times \frac{6}{100} \times \frac{1}{4}}{2} = \$9$$

$$\$600 - \$9 = \$591, \text{ Myers received}$$

6. Interest collected in advance on a loan is called **bank discount**. How much discount did the State Bank retain on the Myers loan? Myers' note is said to be **discounted**.

7. When Myers pays the loan, will he pay \$600 or \$591?

8. If the Myers loan had been for 45 days, would the bank discount have been just half as much? more than half? less than half?

9. If the time of a loan is doubled, does the bank discount double, the rate remaining the same? Prove your answer by discounting the Myers note for 180 days.

Find the bank discount and the proceeds:

10. \$450 at 5% for 60 da. 15. \$200 at 6% for 75 da.

11. \$1000 at $5\frac{1}{2}\%$ for 30 da. 16. \$100 at 6% for 90 da.

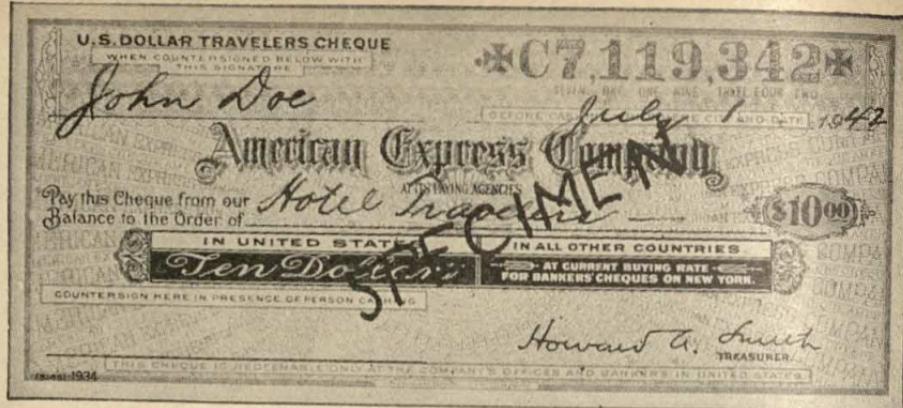
12. \$325 at 6% for 60 da. 17. \$250 at 5% for 20 da.

13. \$600 at 5% for 50 da. 18. \$1200 at 4% for 75 da.

14. \$2500 at $4\frac{1}{2}\%$ for 60 da. 19. \$1800 at 5% for 28 da.

*20. Let d = bank discount, p = proceeds, and f = face of a note. Write the formula for p .

*21. Use the formula (problem 20) to find the proceeds of a \$450 note, discount \$6.82.



TRAVEL MONEY

1. From whom was this travelers check purchased?
2. What is the value of the check?
3. When was it purchased?
4. By whom was it purchased?
5. When John Doe bought the check, how did he sign it? Where?
6. When John Doe cashes the check, how will he sign? Where? Who must see (witness) the signature?
7. Suppose he had signed John Doe when he bought the check and John R. Doe when he was using the check to pay his hotel bill. What difficulty might he have had?
8. "Cashed anywhere" read an advertisement for travelers checks. Why will this form of travel money be cashed so readily?
9. \$10, \$20, \$50, and \$100 checks may be purchased. The price is the amount of the check plus a fee of $\frac{3}{4}$ of 1%, with a minimum charge of 40¢.

Find the cost (amount of check and fee) of the following checks: a. \$50; b. \$100; c. \$800; d. \$250; e. \$1250; f. \$720; g. \$2500; h. 5 \$20 checks and 6 \$50 checks.

- *10. If a travelers check were lost or stolen, could the holder of the check cash it readily? Explain.

FINDING THE TIME BETWEEN DATES

1. The date a note falls due is its **date of maturity**.
On what date did the Myers note (page 116) fall due?

THINK: "There are 27 days left in October. There are 30 days in November and 31 in December, making a total of 88 days to the end of December. Since the note is to run 90 days, it will mature in two days more, or January 2."

2. If the time of a note is stated in days, count forward the exact number of days from the date of the note to find the date of maturity.

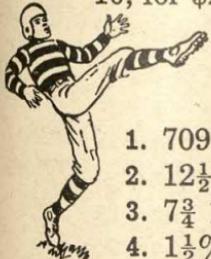
When does a 90-day note, dated March 8, mature?

3. If the time of a note is stated in months, the date of maturity is found by counting forward the exact number of months. For example, a 3-month note, given April 7, will be due July 7.

When will a 4-month note, given March 9, fall due?

Find the time from:

4. June 14 to Sept. 3	7. Sept. 13 to Dec. 5
5. May 3 to Oct. 18	8. Mar. 17 to July 14
6. Nov. 6 to Feb. 11	*9. Jan. 3 to Apr. 16 (leap year)
10. On what date will a 3-month note, given November 10, for \$250 at 6% become due? What will the interest be?	

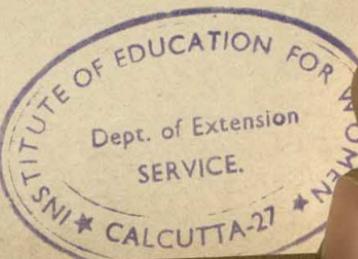


LET'S PRACTICE

5

<i>a</i>	<i>b</i>	<i>c</i>
1. $709 \times 806 = ?$	$15\frac{3}{4} - 9\frac{7}{8} = ?$	$365 \overline{) 17486}$
2. $12\frac{1}{2} \div 3\frac{1}{5} = ?$	$4.6 \times 4.6 = ?$	$9 \div .16 = ?$
3. $7\frac{3}{4} \times 9\frac{1}{2} = ?$	$38 - 15\frac{3}{8} = ?$	$6\frac{3}{4} \times 85 = ?$
4. $1\frac{1}{2}\%$ of 960 = ?	102.5% of 1250 = ?	$36 = ?\% \text{ of } 54$
5. $120 = ?\% \text{ of } 80$	$15 = 30\% \text{ of } ?$	$120\% \text{ of } ? = 480$
6. $\frac{3}{4}\%$ of 200 = ?	$1200 = ?\% \text{ of } 900$	$720 = 180\% \text{ of } ?$
7. To the nearest hundredth, find the decimal value of:		
$a. \frac{6}{7}; b. \frac{7}{12}; c. \frac{11}{16}; d. \frac{3}{8}; e. \frac{2}{3}; f. \frac{5}{6}$.		

119



WHEN MUST I PAY?

Find the date of maturity of each of the following notes:

DATE OF NOTE	TIME	DATE OF NOTE	TIME
1. July 7	60 days	5. March 16	90 days
2. Oct. 10	30 days	6. May 24	6 months
3. Nov. 8	3 months	7. Sept. 1	60 days
4. Jan. 3	30 days	8. July 15	90 days

9. On April 12, Donald's father discounted a 90-day note for \$100 at 6%. What were the proceeds? When did the note mature?

10. A demand note for \$450 at 6% was given July 14 and paid September 9. How much interest was due? What was the face of the note?

*11. On May 1 Mr. Fox signed a demand note for \$500 at 6%. He paid off the note March 1 following. Interest payments were due every 90 days. What were the regular interest dates, and how much was due on each date? How many days were there between the last regular interest payment and the date the loan was paid?

*12. A demand note, dated September 1, is paid off the following September 1. If the interest was due every 90 days, what were the dates for interest payment?

*13. In some years there are exactly 100 days from Easter to the Fourth of July. As Easter always comes on Sunday, on what day of the week will the Fourth of July come in such a year?

*14. In some years there are exactly 64 days from the Fourth of July to Labor Day. As Labor Day always falls on Monday, on what day will the Fourth of July fall in such a year?

USING THE VOCABULARY OF ARITHMETIC

Use correctly in a sentence or give the meaning of each of the following terms. If you do not know the meaning of any term, refer to the key page in parentheses.

amount	(106)	interest formula	(106)
bank discount	(117)	maker of a note	(112)
collateral	(116)	payee of a note	(112)
date of maturity	(119)	proceeds	(117)
demand note	(115)	promissory note	(115)
discounting a note	(117)	rate of interest	(108)
exact interest	(107)	time note	(115)
instalment buying	(109)	travelers check	(118)

*TOPICS FOR SPECIAL REPORTS

1. What is a "clearing house"? Show how checks are handled through the clearing house.
2. How are each of the following used: *a.* a cashier's check? *b.* a letter of credit? *c.* a bank draft?
3. State four ways by which money may be transferred safely from one person to another. Under what conditions would each form be used?
4. Find advertisements which give the cash price and the instalment price of several articles. Compute the interest rate equivalent to the added cost of buying on time.
5. What are "small-loan companies"? What rate of interest is charged by those companies which may serve your community?
6. What is a "secured loan"? What rate of interest is charged for a secured loan?
7. Make a table from which the number of days between any two dates within a year may be found.



HOW WELL DO YOU REMEMBER?



1. What does each letter represent in the interest formula, $i = prt$?
2. Using the interest formula, find i when $p = \$750$, $r = 3\%$, and $t = 60$ days; find i when $p = \$450$, $r = 5\frac{1}{2}\%$, and $t = \frac{1}{2}$ year.
3. What is the difference between simple interest and exact interest? Where is each kind used?
4. Find the rate when the interest on \$750 for 6 months is \$11.25.
5. A vacuum cleaner sells for \$60 cash, or \$10 down and \$6 a month for 9 months. What was the interest charge for buying on instalments?
6. Find the cost of six \$20 travelers checks and four \$50 travelers checks at 75¢ for each \$100.
7. What is the difference between a time note and a demand note?
8. Mr. Wharton discounted his 45-day note for \$650 at 6%. What was the bank discount? the proceeds?
9. If the loan (problem 8) was made July 1, when did it become payable?
10. A 2-month loan was made May 1. How many days from the date of the loan to the date of maturity?
11. A note, dated June 15, was paid July 31. What was the time of the note?
12. Give some of the advantages of instalment buying; some of its disadvantages.
13. If a note is discounted by a bank, does the borrower pay the face of the loan or the proceeds?
14. What is a commercial bank?
15. What are some of the services rendered by commercial banks?

THINGS TO REMEMBER

1. *How to find simple interest.*
2. *How to use the interest formula.*
3. *What is instalment buying, and some reasons why goods usually cost more on instalments than for cash.*
4. *What is bank discount and how to find it.*

TEST ON CHAPTER V

1. Find the interest on \$350 for 75 days at 5%.
2. How many days are there from June 30 to October 15?
3. A loan of \$500 was made at a bank on July 1 for 3 months at 6%. What were the proceeds?
4. Find the amount of a loan of \$360 for 5 months at 6%.
5. Find the bank discount on a 2-month loan for \$250 at 6%.
6. Find r when $i = \$27.50$, $p = \$1000$, and $t = \frac{1}{2}$ year.
7. A used car may be bought at \$325, or \$135 down and \$19.84 a month for 12 months. Find the difference between the cash and the instalment prices.
8. State three things which may make the cost of an article purchased on the instalment plan more than the cash price.
9. About 1.8% of all articles purchased on the instalment plan have to be taken back or reclaimed. What per cent of instalment purchases are paid?
10. What is the difference between a time note and a demand note?
11. Mary heard her father say that the bank discounted his note. What did he mean?

PROGRESS TEST

Solve the problems and perform the indicated operations. If you make errors on this test, turn to the key pages in parentheses where the work is explained.

1. $408 \times 809 = ?$ (9)
2. $9129 \div 16 = ?$ (12)
3. $3\% \text{ of } \$150 = ?$ (65)
4. $12 = ?\% \text{ of } 72$ (66)
5. $.27 \times 76.9 = ?$ (21)
6. $\frac{1}{2}\% \text{ of } 40 = ?$ (72)
7. $100 = ?\% \text{ of } 1000$ (66)
8. $6000 - 4008 = ?$ (8)
9. $50 = 25\% \text{ of } ?$ (74)
10. $.676 \div 26 = ?$ (23)
11. From the sum of $9\frac{1}{8}$ and $3\frac{1}{2}$ subtract $6\frac{3}{4}$. (14)
12. Find the least common denominator of fractions having denominators of 2, 3, 4, 6, and 8. (14)
13. Express as decimals: a. 3% ; b. $\frac{1}{2}\%$; c. 120% ; d. 20% ; e. 102% ; f. 3.5% . (59)
14. Find the sum of: 9.6, 1.8, 0.7, 3.5, 7.4, and 11.6. (20)
15. Name or draw three different kinds of triangles classified according to their angles. (43)
16. What is the difference between a parallelogram and a trapezoid? Draw each. (46)
17. Mr. Jones sold a car for \$765 at a commission of 24% . What was his commission? (65)
18. A news report showed that the number of deaths due to automobile accidents last month was only 80% as many as for the same month last year. If 2592 persons were killed last month, how many were killed in the same month last year? (74)
19. A refrigerator was advertised for \$180 cash, or \$8 down and \$8 a month for 24 months. What was the interest charge? (110)
20. Find the proceeds on a loan of \$450 for 92 days, discounted at 6% . (117)



CHAPTER VI

SAVING AND INVESTING MONEY

1. At the Wilson School 20 pupils in an arithmetic class had saving fund accounts; 15 pupils had none. What per cent were depositors? What per cent were not?

This led to a general class talk on how to save money and how to invest it. Out of the discussion came the following plan which each pupil agreed he could follow as soon as he was working and earning.

I will:

Open a saving fund account	Buy bonds
Open a bank account	Own my home
Insure my life	Buy stock

In this chapter you will solve problems connected with 5 items in the plan. Life insurance will require your attention in Chapter VII.

2. A man from the local saving fund told the pupils that his bank owed its depositors about \$10,000,000; but the saving fund owned property of various kinds worth \$12,000,000. What per cent of its belongings did the bank owe?

*3. One phrase John remembered from the talk by the saving fund man. "Before you invest—investigate!" Test each investment, the man advised. Find out:

Is it safe?	Can I borrow on it?
How much does it pay?	Will it require much attention?
Can I sell it easily?	Will it help me to form
Will it increase or decrease in value?	the habit of saving?

Choose any form of investment you know about and rate it "**High, Medium, Low**" on each of these 7 tests.



THE SAVINGS BANK

1. About 45 million persons in the United States have saving fund accounts. This is one in about how many of our total population (132,000,000 estimated)?
2. These saving fund members have deposits of about 25 billion dollars. How much was this, on the average, for each depositor (to the nearest dollar)?
3. In 1900 we had about 5 million saving fund depositors with savings amounting to about 2 billion dollars. How much more or less does Mr. Average Depositor have now than he had in 1900?
4. About 2,820,000 pupils are depositors in school savings banks. If they have \$14,170,000 on deposit, how much is this a pupil (to the nearest 10¢)?
5. At the close of the school year \$4,660,000 of the deposit (problem 4) remained with the banks. What per cent was this? What per cent of the funds had been withdrawn?
6. One of our states had 10,500,000 saving fund depositors and $7\frac{1}{2}$ billions in savings. How much more or less was this a depositor than the average for the country (problem 2) (to the nearest dollar)?
7. If the average interest on saving funds is $1\frac{1}{2}\%$, about how much are these funds paying to their depositors each year (problem 2)? How much is this a depositor to the nearest 10¢?
8. Savings banks, and commercial banks as well, rent small steel boxes in which valuables may be placed. These are called safe deposit boxes. They may rent for \$5, \$10, \$15 or more a year, depending on the size of the box.

If a bank rented 236 boxes at \$5, 71 at \$10, and 26 at \$15, what annual rental would it receive from these boxes?

HOW BANKS EARN MONEY

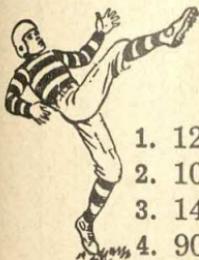
The renting of safe-deposit boxes (page 127) is one way a bank earns—a very small way. Other services which banks offer bring in far more profit.

1. Mr. Business Man drops in for a loan. "About \$500 will be enough," says he, "and how much will it cost?" "6%," replies the banker, "and interest payable every 3 months." How much interest does Mr. Business Man pay at the end of each period? (HINT: Interest rates are based on a year unless otherwise stated.)
2. The local street railway needs some new streamlined cars and busses. It borrows \$250,000 at 4% from the bank.
 - a. How much interest must the trolley company pay every 6 months?
 - b. If the loan must be repaid at the end of 10 years, how much will the borrowing cost the company? (HINT: Interest plus principal.)
 - c. How much will the loan have earned for the bank?
3. The United States Government takes 2 millions of the bank's money and gives its written promise to pay in 20 years with interest at 2% a year. This is a **bond**.
 - a. How much does the loan earn for the bank?
 - b. How much does it cost the Government?
4. Miss Depositor likes to pay her bills by check but is unable to keep very much money on deposit. So the bank makes a charge of \$1 a month for her account plus 5¢ for each check she draws. If Miss Depositor draws 25 checks a year, how much does her account earn for the bank?
5. Mr. Traveler buys travelers checks at the bank—5—10's; 4—20's; 2—50's; 1—\$100. What is the bank's fee for this service (page 118)?

\$50,000 FORGOTTEN!

Savings banks add interest earned to each depositor's account yearly or whatever the period may be. They do not send checks nor notify him in any other way. Now and then a depositor forgets his account or dies without anyone (but the bank) knowing of the deposit. Interest continues to pile up for 20 years, after which the account becomes **dormant** and no longer earns.

1. If the number of dormant saving fund accounts in the United States in a recent year was about 5,650,000 and the amount on deposit was \$189,000,000, how much was that, on the average, for each account (to nearest dollar)?
2. There were 1211 dormant accounts having deposits from \$10,000 to \$50,000. If the average was \$12,700, how much was deposited in these accounts?
3. There were 65 dormant accounts having deposits of more than \$50,000 each. If the average was \$56,250, how much was deposited in these accounts?



LET'S PRACTICE PER CENTS



a

b

c

1. 12% of 45 = ?	2% of 730 = ?	$\frac{1}{2}\%$ of 650 = ?
2. 106% of 850 = ?	140% of 68 = ?	$2\frac{1}{2}\%$ of 1000 = ?
3. $14 = ? \%$ of 70	75 = ? % of 60	$1 = ? \%$ of 200
4. $90 = ? \%$ of 15	15 = ? % of 90	$100 = ? \%$ of 75
5. $15 = 10\%$ of ?	50 = 2% of ?	$75 = 25\%$ of ?
6. 102% of 380 = ?	48 = ? % of 16	$45 = 60\%$ of ?
7. Write as per cents: a. $\frac{3}{4}$; b. 5; c. .9; d. 1.7.		
8. Write as decimals: a. 4%; b. $2\frac{1}{2}\%$; c. 101%; d. 10%.		
9. Round off the following to the nearest whole per cent: a. 34.45%; b. 6.5%; c. 12.75%; d. 26.495%.		

TREND OF DEPOSITORS' LOSSES BEFORE BANK INSURANCE - AND AFTER



INSURING BANK DEPOSITS

1. "The bank closed and I lost all my money," was heard many times during the business depression which began in 1929. Two years later (1931) 2300 banks failed. What per cent was this of the 22,000 banks in the United States at that time?

2. Something had to be done to protect the deposits of Mr. and Mrs. United States. So a new Government service was offered (1934) under the name, **Federal Deposit Insurance Corporation**. This insurance cost banks $\frac{1}{12}\%$ a year of their deposits. How much was this for a bank having \$840,000 in deposits?

3. If a member bank fails, the deposit insurance corporation sees to it that each depositor gets his money up to \$5000. If your family had \$7200 in a closed bank, how much is not insured?

4. From 1921 to 1934, bank failures in the United States totaled about 14,000. To the nearest hundred, what was the average number of bank failures each year?

5. Since 1934 (year F. D. I. C. was formed) bank failures have averaged less than 50 a year. This is about how many (on the average) for each state?

6. In which year (page 130) were losses from bank failures greatest? About how much was lost that year?

7. a. The period, 1925-1928, was one of great prosperity. Were the average yearly bank losses for that period more or less than the losses from 1934 on?

b. What evidence have you from the picture graph (page 130) that the F. D. I. C. has been successful?

*8. Here are topics for brief floor talks. Choose one.

- a. All banks should be required to join F. D. I. C.
- b. What is a panic? a depression? boom times?

HOW SAVINGS GROW

1. Jane Brooks had quite a surprise on her 17th birthday. Her father gave her a present of \$200. If Mr. Brooks invested \$100 at 4% when Jane was born, how long did it take the money to **double itself** (\$1 to become \$2)?

2. If Jane reinvested her \$200 at 4%, how old will she be before it amounts to \$400?

3. For many years in the United States, people with money to lend could get 6% interest. At this rate money doubles itself in about 12 years. Suppose a child at birth received a gift of \$50 and the money was put out at 6%. How much will he have if he lives to age 48?

4. The interest rate at the Mutual Savings Bank was 2%, payable semiannually. If Mr. Lance deposited \$100 in the Mutual Bank (and withdrew nothing), how much would he have at the end of 2 years?

\$100.00	original principal
1.00	int. for 6 mo.
\$101.00	principal after 6 mo.
1.01	int. for 6 mo.
\$102.01	principal after 1 yr.
1.02	int. for 6 mo.
\$103.03	principal after $1\frac{1}{2}$ yr.
1.03	int. for 6 mo.
\$104.06	principal after 2 yr.

- a. What was his original principal?
- b. How much interest did it earn in 6 months? (This is simple interest.)
- c. How much was on deposit at beginning of second 6-month period? (This is the **amount**—principal plus interest.)
- d. How much interest was earned during the second 6-month period? How much more was this than the interest for the first period? (This excess is **compound interest**—interest on interest.)
- e. What is the simple interest at the end of the 2nd year? the compound interest? the amount?

f. Why was the interest for each period computed at 1% when the Mutual rate was 2%?

5. If the interest rate is 3%, what is the semiannual rate? the quarterly rate?

6. At the end of one year \$100 at 4%, compounded quarterly, is how much more or less than \$100 at 4% compounded semiannually?

7. If \$500 at 4% is compounded quarterly, the compound interest for one year is how much greater than simple interest for the same time and rate?

8. If the interest is compounded yearly, find the compound interest on

a. \$100 at 3% for 3 yr.	c. \$500 at 4% for 2 yr.
b. \$100 at 4% for 3 yr.	d. \$600 at 2% for 3 yr.

9. The compound interest (examples *a* to *d*) is how much more than simple interest?

*10. In 1626 the Dutch bought the island of Manhattan (now part of New York City) for about \$24. Suppose the purchase price had been put at 6% simple interest until 1926 (300 years), how much would it have earned?

*11. Suppose the purchase price had been compounded annually at 6% for 300 years, what would have been the amount in 1926? This problem would take so long to solve that we give you the answer: \$942,069,324. The compound interest is about how many times the simple interest?

*12. Using *p* for principal, *i* for interest, and *a* for amount, write the formula for *a*.





OWN YOUR OWN HOME

1. The Clayton family saw a house they liked. Its price, \$6000, was \$3500 more than they had. What per cent of the price of the house did they have? did they lack?
2. Mr. Clayton discussed the purchase of the house with his saving fund. "We will lend you \$3500," said the banker, "at 6%, payable semiannually." How much interest was due each 6 months?
3. "This loan will be for 5 years," continued the banker, "after which the \$3500 will be due and payable." What will be the total interest cost on the loan?
4. "May I arrange to pay off something on the loan each year?" asked Mr. Clayton. "Very wise," replied the banker. "Suppose we say 5 equal instalments?" How much was due on each instalment?
5. What was the balance of Mr. Clayton's loan during the second year? The interest due each 6 months?
6. What was the balance for each of the remaining years and the semiannual interest at each due date?
7. Mr. Clayton pledged his new house as security that he would pay interest and instalments when due. Such a written pledge of property for the payment of a debt is a **mortgage**. The amount borrowed is the **principal**. What was the principal of the Clayton mortgage?

MORTGAGE FACTS

1. In some states, savings banks are permitted by law to lend on mortgages up to 60% of the value of a property. If a property is valued at \$8500, how much will these banks lend? How much must the buyer put up?

2. How much would bank and buyer each supply if the bank loans 50% of the value of the house?

3. A family should not pay more than twice its yearly income for a house in which to live. The Clayton family has an income of \$275 a month. How much can it afford to pay for a home?

4. What per cent of the purchase price of the home (problem 3) would a mortgage of \$4000 be?

5. A house, mortgaged at \$7500, is let go at a sale for \$7200. What per cent of the mortgage is the sale price?

Who shoulders the \$300 loss—the **mortgagee** (person who lent the money and holds the mortgage) or the **mortgagor** (person who borrowed the money and gave the mortgage)?

6. Find the missing amounts:

	COST OF PROPERTY	MORTGAGE (% OF COST)	RATE OF INTEREST	YEARLY INTEREST
a.	\$7500	60%	5%	?
b.	\$4800	50%	4½%	?
c.	\$3500	40%	4%	?
d.	\$5400	55%	6%	?
e.	\$4200	35%	3%	?
f.	\$6400	60%	5½%	?

7. Find the amounts of the following mortgages:

INTEREST	RATE	INTEREST	RATE	INTEREST	RATE
a. \$150	5%	d. \$120	5%	g. \$240	5%
b. \$240	6%	e. \$720	4%	h. \$180	6%
c. \$ 90	4%	f. \$ 90	4½%	i. \$ 75	5%



SHALL I RENT OR BUY?

Mr. Carter, a newcomer to the Clayton-Fields community, was undecided whether to rent or to buy.



1. A house, suited to the Carter family, was vacant and could be bought for \$7000. Carter earned \$75 a week. Why could Carter afford to buy this house? (Purchase price should not be more than twice the yearly income.)

2. The house could be rented at \$65 a month. Why, in your judgment, could Carter afford to rent the house? (Monthly rental should not exceed 25% of income.)

3. Carter decided to buy. He put in \$3000 of his money and gave a mortgage at 5% for the remainder. What was the annual interest on the mortgage?

4. If Carter's money had been invested at 3%, how much did he lose when this money went into the house?

5. The Carter property paid taxes, \$165, and \$16 for insurance against loss by fire. \$105 a year went for repairs, and $2\frac{1}{2}\%$ for depreciation (decrease in value through use or other reasons). What was the sum of these charges?

6. What was the total cost a year to Carter for his house? (HINT: Remember interest on Carter's \$3000.)

7. How much less did it cost Carter to own his home than to rent at \$65 a month? What per cent less?

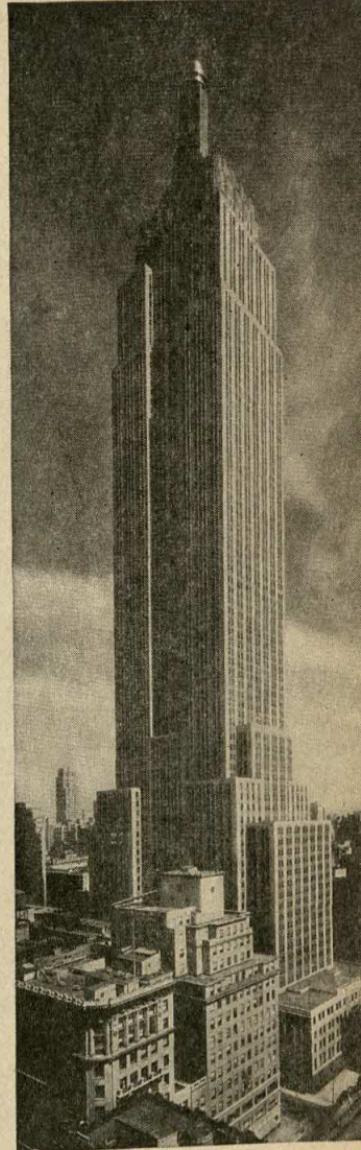
8. The table shows the income of 6 families and how much each family can afford to pay for a home. The price each can pay is what per cent of its income for 2 years?

	YEARLY INCOME	CAN PAY		YEARLY INCOME	CAN PAY		YEARLY INCOME	CAN PAY
a.	\$1800	\$3200	c.	\$3000	\$5700	e.	\$6000	\$11,500
b.	\$2100	\$4000	d.	\$5000	\$9500	f.	\$8000	\$15,000

BUY BONDS

Railroads borrow money and give their bonds for security, as do manufacturers of automobiles and, indeed, all other kinds and types of businesses, and political units such as cities and states.

1. Who is the maker (organization which issued it) of the bond on page 138?
2. For what amount (*face*) is the bond written?
3. What rate of interest is promised?
4. How often must this interest be paid?
5. To whom (*payee*) must the interest and the face of the bond be paid?
6. When must the face of the bond be paid (*date of maturity*)?
7. Did the Good Foods Co. borrow or lend the \$1000?
8. Did John R. Scott borrow or lend the \$1000?
9. Good Foods will send check for interest on bond (page 138) to John R. Scott every 6 months. For how much will each check be?
10. How much interest must Good Foods pay to Scott during the life of this bond?
11. What per cent of the face of the bond did the borrowing cost Good Foods?



Built by Bonds

UNITED STATES

NUMBER

18

OF AMERICA.

1000

1000



GOOD FOODS COMPANY

Know All Men by These Presents, That the GOOD FOODS COMPANY, a corporation duly organized and existing under the laws of the State of Indiana, hereinafter called the "Company," which term shall include any successor corporation, for value received, promises to pay to bearer, or if this bond be registered, to the registered holder hereof, the sum of One Thousand (\$1000) Dollars, lawful money of the United States of America, on the first day of January, 1952, with interest thereon at the rate of 5% per annum, payable semiannually on the first day of January and of July.

This bond is one of a series of one hundred (100) bonds numbered from 1 to 100, both inclusive, amounting in the aggregate to One Hundred Thousand (\$100,000) Dollars, for the purpose of installing and putting into operation machinery for the quick-freezing of vegetables, fruits, and meats, and the purchasing of refrigerated trucks for marketing these quick-frozen vegetables, fruits, and meats.



In Witness Whereof, the Good Foods Company has caused these presents to be signed in its name and behalf by its president and its secretary thereunto duly authorized, and its corporate seal to be hereto affixed, the first day of January, 1942.

GOOD FOODS COMPANY

The bond held by John R. Scott.

BIG CITY SELLS BONDS

1. "Here is our check for \$43,355,000," said the cashier of the bank to the mayor of Big City, "and thanks for the truck load of city bonds." Big City needed new subways and other improvements. The bank had money to lend. Tell how one helped the other.
2. Each Big City bond had a face value of \$1000. How many bonds were on the truck?
3. The bonds bore interest at 2.95%. What was the interest on each bond each year?
4. How much interest did Big City pay each year on all these bonds?
5. The bonds mature 30 years from the date issued. How much interest will Big City have paid on these bonds during that time?
- *6. Each year Big City took one million dollars of its tax money and invested it so as to have money to pay off the bonds when they came due. Big City put money into its "**sinking fund**," as we say. How much compound interest must the sinking fund earn? (HINT: Face of bonds less \$1,000,000 a year for 30 years.)
- *7. How much more or less did Big City pay as interest on its bonds than the sinking fund earned?



HOW'S THE BOND MARKET TODAY?

1. With your teacher's permission, we are going to assign your lesson for tomorrow. Bring in the "Bond Market Report" from your newspaper. Find in the report the name of one railroad that serves your community. Copy what is printed about that railroad.

2. Mary lives in Pennsylvania. She copied:

ISSUE	RATE OF INTEREST	DATE OF MATURITY	SALES IN \$1000	HIGH	LOW	CLOSE
Pennsylvania Railroad	3½%	1952	14	86½	86	86¼

The answers to the following questions are contained in Mary's copy.

- a. How many thousand dollars of these bonds were sold that day?
- b. What railroad issued the bonds?
- c. What was the highest price at which these bonds were sold that day? (HINT: $86\frac{1}{2} = 86\frac{1}{2}\%$ of \$1000.)
- d. What was the lowest price?
- e. When do these bonds mature?
- f. What rate of interest do they bear?
- g. At what price were these bonds selling when the market closed for the day?

3. Each big city has a market where bonds are bought and sold. Sometimes this market is combined with the **stock exchange**, about which you will study on page 147.

What city bond market reports appear daily in your newspaper?

*4. What is meant by:

- a. Bethlehem Steel 3½'s, 1960?
- b. Atlantic Transportation Company 5's, 1958?
- c. Baltimore & Ohio Railroad 4½'s, 1956?
- d. U. S. Treasury, 2¾'s, 1965-'60?

5. Men called **brokers** will buy or sell bonds for you. Their charge, usually \$2.50 for each \$1000 bond (**face value**), is called a **brokerage fee**, or **commission**.

What was the fee for selling the Pennsylvania Railroad bonds quoted by Mary (problem 2)?

6. a. If each Pennsylvania Railroad bond (problem 2) had a face value of \$1000, at how much less than face value was it selling?

b. The price of the bonds in Mary's newspaper is the market price. Why is it so called?

7. Find the cost of a \$1000 bond, including brokerage \$2.50, quoted at $96\frac{1}{2}$.

The quotation $96\frac{1}{2}$ means $96\frac{1}{2}\%$ of face value.

The bond will cost $.965 \times \$1000$, or $\$965$.

$\$965 + \$2.50 = \$967.50$, cost of bond plus brokerage.

Find the market value of a \$1000 bond quoted at:

8. 97 10. $106\frac{1}{2}$ 12. $87\frac{1}{2}$ 14. $100\frac{1}{2}$
9. 103 11. $89\frac{3}{4}$ 13. $110\frac{1}{4}$ 15. $100\frac{1}{4}$

16. How much will be received from a \$1000 bond sold at $101\frac{1}{2}$ after deducting the broker's commission?

17. If a \$1000 bond is sold below face value, why is the commission for selling it the same as if it were sold at face value?

18. A commission of \$2.50 for selling a \$1000 bond is what per cent of the face value of the bond?

*19. How do coupon bonds differ from registered bonds?





ANY BONDS TODAY?

At school James had bought savings bonds. He knew that by keeping them a number of years, he would get his money back with interest. He knew that there can be no safer investment. So he was proud to own savings bonds. But this is the way he found out what savings bonds really are:

1. "Why not buy a United States Savings Bond?" said the saving fund man to James, one day as James was mak-

ing a deposit to his account. "A bond can be bought for as little as \$18.75 and in 10 years it will be worth \$25." What rate of interest does it earn in 10 years? How much is this a year, on the average?

"When your name goes on one of these bonds," continued the banker, "you own a written promise, signed by your Government, to pay **you** a definite amount of money with interest at a certain time."

"United States Savings Bonds," thought James, "are only **long-term promissory notes** which are evidence of money lent to the Government."

2. United States Savings Bonds can be purchased at various prices, as shown in the following table, and can be cashed at any time for the amounts listed under each price.

PRICE	\$18.75	\$37.50	\$75.00	\$375.00	\$750.00
REDEMPTION VALUES AFTER THE ISSUE DATE					
1st yr.....	\$18.75	\$37.50	\$75.00	\$375.00	\$750.00
2nd yr.....	\$19.00	\$38.00	\$76.00	\$380.00	\$760.00
3rd yr.....	\$19.25	\$38.50	\$77.00	\$385.00	\$770.00
4th yr.....	\$19.75	\$39.50	\$79.00	\$395.00	\$790.00
5th yr.....	\$20.25	\$40.50	\$81.00	\$405.00	\$810.00
6th yr.....	\$20.75	\$41.50	\$83.00	\$415.00	\$830.00
7th yr.....	\$21.50	\$43.00	\$86.00	\$430.00	\$860.00
8th yr.....	\$22.50	\$45.00	\$90.00	\$450.00	\$900.00
9th yr.....	\$23.50	\$47.00	\$94.00	\$470.00	\$940.00
10th yr.....	\$24.50	\$49.00	\$98.00	\$490.00	\$980.00

a. What price bonds are issued?

b. How much is each bond worth at maturity?

3. The purchase price of a savings bond is what per cent of the maturity value?

4. If a bond is held to maturity, the interest is what per cent of the maturity value?

5. Mr. Hammond paid \$75 for a savings bond and turned it in at the end of 6 years. How much cash did he receive for the bond? How much of this was interest? What per cent interest was this a year (on the average)?

6. His neighbor, Mr. Black, held his \$75 savings bond to maturity. What rate of interest did his bond earn a year (on the average)? How much better was Black's average interest rate than Hammond's? Why?

*7. The rate of compound interest paid on a savings bond is about 2.9%. How much more or less is this than the rate paid by savings banks in your community?

*8. Savings bonds are payable to the owner and to no one else. His name is on the bond. Why are such bonds called "registered bonds"?

*9. "Best security in the world," said a speaker at a rally for the sale of savings bonds. Tell why you agree.

THE LOWELL CANDY COMPANY

After the first of the year and until Easter, James Lowell did a thriving business selling Easter eggs among his friends. Several of his schoolmates wished to join him in the work, so James formed **The Lowell Candy Company**.

He estimated that he would need \$15 to keep his enlarged business going until it began to earn. So he sold 150 shares of ownership (called **stock**) at 10¢ a share.

Each pupil who bought one or more shares became a **stockholder** (part owner of the business).

1. If all 150 shares of stock were sold, how much money was received? This amount is known as the **capital** of the company; and the stock, as its **capital stock**.

2. If Stanley owned 5 shares of stock, what per cent of the company did he own?

3. In 2 weeks The Lowell Candy Company had earned \$15. The stockholders decided to divide this profit on the basis of 5¢ for each share held. Money earned by a company and divided among the owners (stockholders) is called a **dividend**. If James Lowell held 20 shares, what was his dividend?

4. How much was the total dividend declared?

5. The dividend was what per cent of the capital stock?

6. At the end of the first month of operation a second dividend of 5¢ a share was paid. The 2 dividends were what per cent of the value of the stock?

7. Mary offered James 20¢ a share for half the stock which he owned. How much in all did she offer?

8. At the end of the first month of operation the principal of James' school billed the company \$5 for the privilege of selling candy within the school building.

a. What per cent of the month's earnings of \$30 was this charge? b. How might it affect the next dividend?

BIG BUSINESS

The Lowell Candy Company operated in a small way and with permission only of the school principal. The railroad that serves your neighborhood, however, has thousands of stockholder-owners, serves many communities, and was granted permission to run trains by one of our state governments. This right is called a **charter**; and the railroad a **corporation**—that is, a group of people who obtain a charter giving them, as a group, certain rights.

1. Page 146 shows a stock certificate given to each stockholder as a receipt for shares purchased by him.

a. What is the value of this certificate as printed on the face (**par value**)?

b. If a stockholder owned 150 shares of the stock, what would its total par value be?

c. Stock certificates may contain any face (or **par**) value or none at all (**no par value**). What would be the par value of the stock (problem b) if the certificate were marked \$5 a share? \$10? \$25? \$50?

2. If a corporation issues 100,000 shares of stock at \$10 par value, what is the par value of all of this stock?

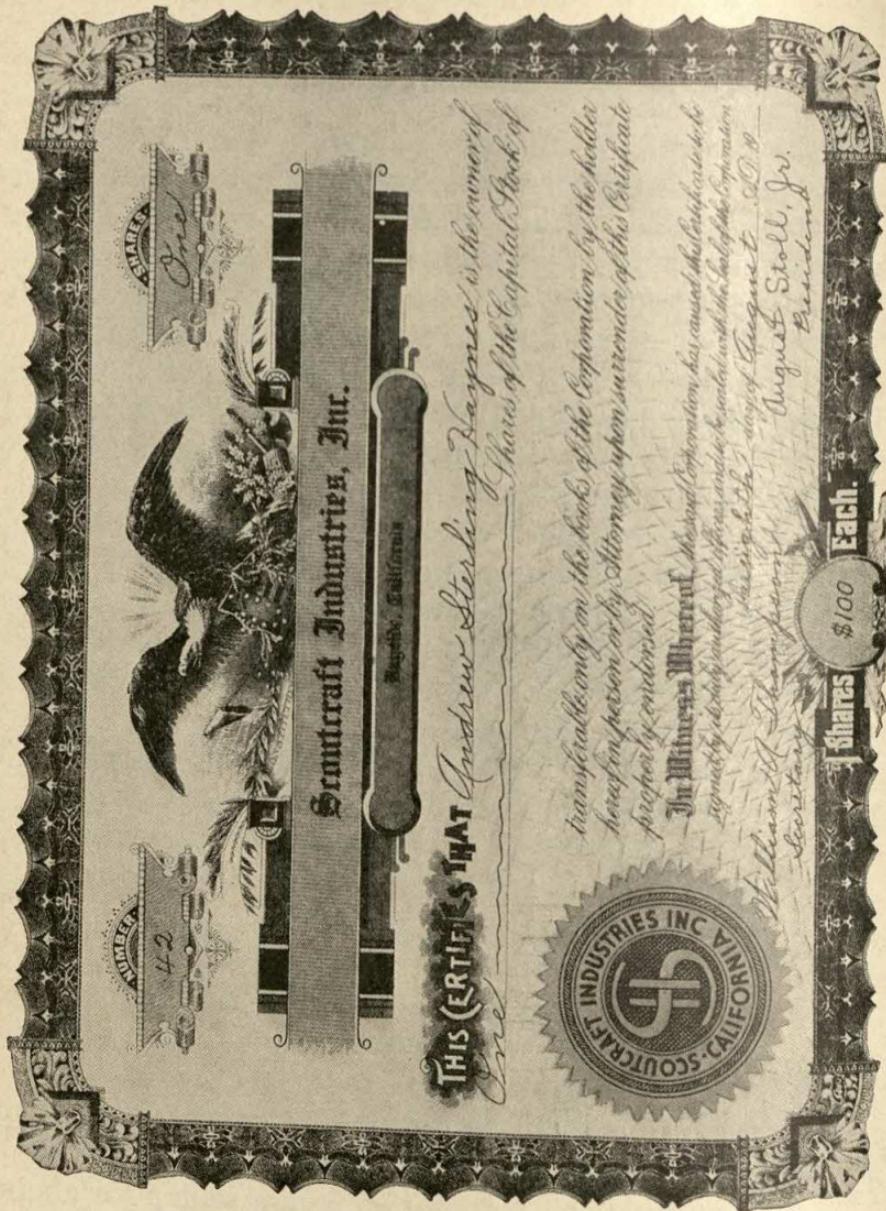
3. One share of this stock (problem 2) represents what part of the ownership of the company?

4. How many shares must I have to own 1% of this company (problem 2)?

5. In boom times the stock (par value \$100) of one big American corporation was selling at \$279 a share (**market price**). What per cent of the par value was this?

6. During a period of hard times this stock dropped to \$7.50 a share. What per cent was this of the par value?

7. The stock of this corporation is now selling for about \$52 a share. What per cent is this of par?



THE STOCK EXCHANGE

In your lesson (page 140) you brought to class bond market reports. The same section of your newspaper probably contains three or more full-length columns of "stock transactions." Every large American city has a market (called stock exchange) where brokers buy and sell stocks. The New York Stock Exchange does more business than any other stock market in the world.

The fee (brokerage) for stocks bought or sold on the New York Stock Exchange is given in the following table.

PRICE A SHARE	FROM \$10 TO \$24 $\frac{1}{2}$	FROM \$25 TO \$49 $\frac{1}{2}$	FROM \$50 TO \$74 $\frac{1}{2}$	FROM \$75 TO \$99 $\frac{1}{2}$	FROM \$100 TO \$199 $\frac{1}{2}$
FEE A SHARE	12 $\frac{1}{2}$ ¢	15¢	17 $\frac{1}{2}$ ¢	20¢	25¢

1. Find the cost, including brokerage, of 100 shares of stock bought at $46\frac{3}{4}$.
2. Find the cost, including brokerage, of 200 shares of stock bought at $83\frac{1}{4}$.
3. For stocks selling from \$1 to \$10 a share, the brokerage for 100 shares is \$7.50. Find the cost, including brokerage, of 100 shares of stock bought at $7\frac{3}{4}$.
4. For stocks selling from \$200 to \$250 a share, the brokerage is 30¢ a share. Find the cost, including brokerage, of 100 shares of stock bought at $214\frac{1}{2}$.
5. Find the cost, including brokerage, of 5 shares at $99\frac{7}{8}$. (HINT: The fee for buying or selling is never less than \$3.)
- *6. Do you know anyone who works in a stock market of any of our large cities? Interview him, and then tell your class about his work. Does he say that stocks and bonds are important? Why?

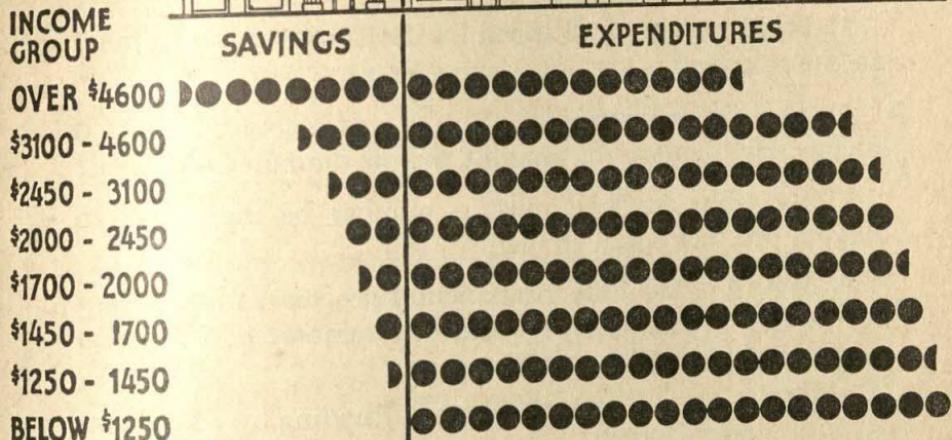
HOW IS THE STOCK MARKET TODAY?

Here is a report of a few stock market "transactions" (purchases and sales of stock) copied from the "New York Stock Transactions" printed daily in newspapers of large circulation.

NEW YORK STOCK TRANSACTIONS					
SALES	NAME OF STOCK	OPEN	HIGH	LOW	CLOSE
2600	A. T. and T.	161 $\frac{5}{8}$	162 $\frac{5}{8}$	161	161
900	Coca-Cola	88 $\frac{1}{4}$	88 $\frac{1}{4}$	87 $\frac{3}{4}$	87 $\frac{3}{4}$
23000	Gen. Motors	57 $\frac{1}{4}$	58 $\frac{3}{4}$	57 $\frac{1}{4}$	57 $\frac{3}{4}$
8800	U. S. Steel	48 $\frac{1}{4}$	49 $\frac{1}{2}$	48 $\frac{1}{4}$	48 $\frac{7}{8}$

The answers to the following questions are contained in the above stock quotations:

1. a. How many shares of A. T. & T. (American Telephone and Telegraph Company stock) were sold that day?
b. What was the highest price at which the stock sold that day ($\frac{5}{8} = 62\frac{1}{2}\text{¢}$)? the lowest?
c. At what price was the first sale (open) of this stock made that day?
d. At what price was the last sale of A. T. & T. made?
2. Answer questions (a-d) about each of the other stocks listed.
3. Find the difference between the opening and the closing price of each stock. Which closed higher than it opened? lower?
4. Find the cost of 100 shares of A. T. & T. at the opening quotation. (Use brokerage rates as on page 147.)
- *5. In your daily newspaper, find the quotations of the stocks given above and compare prices.



● Represents 5 per cent of income of group

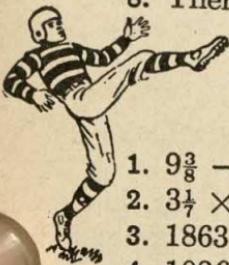
HOW MUCH SHOULD BE SAVED?

Families must have food, clothing, shelter, and other needful things. How much of the family income should go for these necessities and how much should be saved? The picture graph answers this question for families in eight income groups.

1. What does each disc on the graph represent?
2. How many discs are used to represent the income of each group?
3. About what per cent of income was saved by the \$1250-\$1450 group? If the average income for this group was \$1320, what was the average savings?
4. How many of the income groups saved as much as 20% of their annual incomes?
5. The annual family income had to be at least what amount before the average savings were at least 10% of the income?

*INFORMATION PLEASE!

1. What number multiplied by itself has a product equal to the number?
2. The circumference of a circle was increased about 6 inches. By about what amount was its diameter increased?
3. By what fraction must a number be multiplied to have a product equal to one?
4. Which of the four fundamental processes may be performed on both numerator and denominator of a fraction without changing its value?
5. Multiplying by 5 is the same as dividing by what number?
6. A 6-inch square has the same area as a rectangle. Give two sets of dimensions for the rectangle.
7. A diagonal is drawn from a vertex of a regular hexagon to the opposite vertex. What two figures are formed?
8. There are how many meters in 0.6 kilometers?



LET'S PRACTICE

<i>a</i>	<i>b</i>	<i>c</i>
1. $9\frac{3}{8} - 5\frac{3}{4} = ?$	$6039 \div 17 = ?$	$796 \times 308 = ?$
2. $3\frac{1}{7} \times 6\frac{1}{4} = ?$	$3.7 \times 48.5 = ?$	$7 - .14 = ?$
3. $18637 - 348 = ?$	$8\frac{1}{2} - 2\frac{3}{4} = ?$	$\frac{7}{8} = ? \%$
4. 102% of 540 = ?	$\frac{1}{4}\% \text{ of } \$75,000 = ?$	3.2% of 1460 = ?
5. $15 = ? \%$ of 120	$35 = ? \%$ of 20	$1 = ? \%$ of 200
6. $24 = 6\% \text{ of } ?$	$120 = 150\% \text{ of } ?$	$4.6 = 5\% \text{ of } ?$
7. Express as per cents: <i>a.</i> 1.3; <i>b.</i> .006; <i>c.</i> $\frac{5}{6}$; <i>d.</i> .0325.		
8. Arrange in order of size, beginning with the smallest: $\frac{3}{4}, .7, \frac{2}{3}, 1, .1, \frac{5}{8}, 1.1.$		

USING THE VOCABULARY OF ARITHMETIC

Below are terms which were used in this chapter. Define each term or use it correctly in a sentence. If you have forgotten a term, turn to the key page in parentheses.

amount	(132)	mortgage	(134)
bond	(137)	par value	(145)
brokerage	(141)	principal	(134)
compound interest	(132)	registered bond	(141)
coupon bond	(141)	savings bank	(127)
date of maturity	(137)	stock certificate	(145)
dividend	(144)	stock exchange	(147)
face value	(141)	stockholder	(144)
market price	(145)	U. S. Savings Bonds	(142)

*TOPICS FOR SPECIAL REPORTS

1. What is the Federal Housing Administration? How may the purchase of a house be financed through this Federal agency?
2. Find the meaning of the following: *a.* a mortgage bond; *b.* a debenture bond; *c.* a sinking fund bond; *d.* a serial bond.
3. What is the difference between common and preferred stock? Under what conditions would you recommend each as a good means of investment?
4. Tell the story of the New York Stock Exchange. What is meant by a seat on this exchange? About what is its value today?
5. *a.* "Compound interest is interest on interest." What does that mean?
b. Distinguish among compound interest, simple interest, and exact interest.
c. What 3 things determine the amount of interest?



HOW WELL DO YOU REMEMBER?

1. Mrs. Moore deposited \$1500 in a savings bank paying $1\frac{1}{2}\%$ interest. What is the interest each year? the semiannual interest?
2. Mr. Stanton bought a house for \$7200 and gave a mortgage for 60% of the cost. What was the amount of the mortgage?
3. What was the yearly interest on Stanton's mortgage (problem 2) at $5\frac{1}{2}\%$? the semiannual interest?
4. A bond is quoted: Penn. R. R. 4's, 1948, $108\frac{1}{2}$. State what this means.
5. Find the cost of a \$1000 bond (problem 4) including brokerage of \$2.50.
6. Find the cost, including brokerage, of 100 shares of stock bought at $62\frac{1}{4}$. (See page 147 for brokerage rate.)
7. A broker bought 100 shares of stock for one of his customers at $46\frac{1}{4}$. The next day the broker sold the stock for the customer at 47. If the brokerage for each transaction was \$15, how much was the customer's profit?
8. What is the chief thing to consider when investing money?
9. When interest is compounded annually, how much difference, if any, is there between simple and compound interest on \$1000 at 2% for 1 year? for 2 years?
10. If a bond is bought at a discount, is it selling above or below its face value?
11. If a stock has a par value of \$100 and it is sold at $87\frac{1}{4}$, how much below par value is it selling?
12. Using the rate given on page 147, find the cost, including commission, of 100 shares of this stock (problem 11).

THINGS TO REMEMBER

1. *What is compound interest and some of its uses.*
2. *What is a mortgage.*
3. *What is a bond and some of the different kinds of bonds.*
4. *What is a share of stock and how stocks may be purchased.*

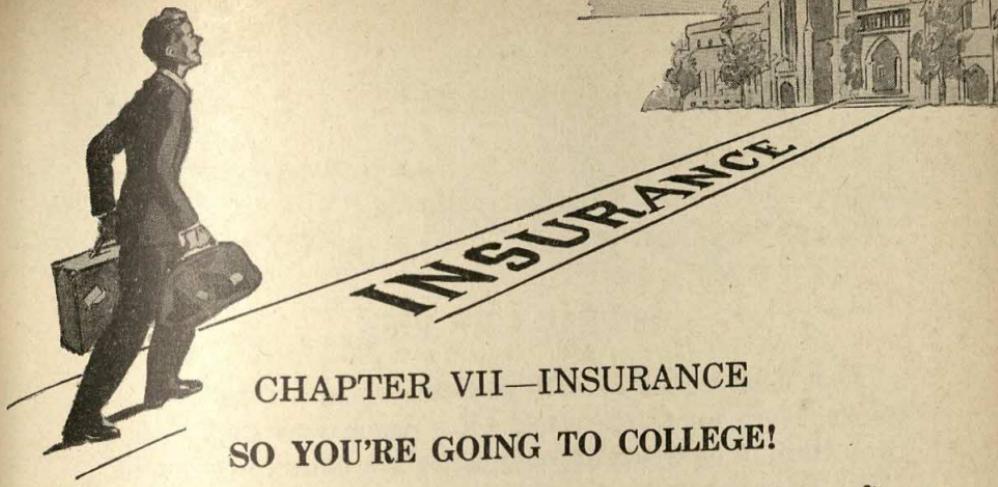
TEST ON CHAPTER VI

1. Mrs. Brown had \$740 in a savings bank paying $1\frac{1}{2}\%$. How much interest was credited to her account at the end of 6 months?
2. How much more or less than simple interest is the interest on \$100 for 2 years at 2% , compounded annually?
3. How much will \$100 amount to in 2 years at 4% , compounded semiannually?
4. Mr. Griffith bought a house for \$6800 subject to a mortgage of \$3500 at $5\frac{1}{2}\%$. What is the yearly interest on the mortgage?
5. Mr. Schwartz bought a \$1000 bond at $89\frac{3}{4}$. What did he pay for the bond (do not include brokerage)?
6. At the end of 5 years what will be the value of three United States Savings Bonds bought at \$37.50 (page 143)?
7. If General Motors stock is quoted at $52\frac{3}{4}$, how much will 100 shares of this stock cost (brokerage not included)?
8. Find the brokerage on the General Motors stock (problem 7) using the rate given on page 147.
9. Name three ways in which stocks differ from bonds.
10. Find the cost, including brokerage, of 20 shares of stock bought at $114\frac{1}{2}$. (If fewer than 100 shares are bought, the brokerage is " $\frac{1}{8}$ of a point" higher a share than given on page 147. HINT: Add $\frac{1}{8}$ to $114\frac{1}{2}$.)
11. A stockholder who bought stock at \$279 a share and sold at \$7.50 lost how much a share? what per cent?

PROGRESS TEST

If you make errors on this test, turn to the page in parentheses where the work is explained.

1. $502 \times 978 = ?$ (9)
2. $.38 \overline{) 15.428}$ (22)
3. From $36\frac{3}{4}$ subtract $16\frac{11}{12}$. (14)
4. Add $7\frac{1}{4} + 11\frac{3}{8} + 9\frac{5}{6} + 4\frac{1}{2} + 5\frac{2}{3}$. (14)
5. How much more than 456.8 is 1000.5? (20)
6. Find the area of a square which is 7.5 feet on a side. (38)
7. Which is greater and how much, a rectangular rug $9' \times 12'$ or a rug $8\frac{1}{2}' \times 12\frac{1}{2}'$? (37)
8. Find the area of a triangle having a base, 8 inches, and an altitude, 15 inches. (40)
9. Find C in $C = \pi d$ when $d = 9$, and $\pi = 3.14$. (49)
10. Find the area of a circle whose radius is 14 inches. (Use $\pi = 3\frac{1}{7}$) (51)
11. A merchant received a bill for merchandise amounting to \$420 less a discount of 35%. What was the net cost of the merchandise? (79)
12. $17 \overline{) 10033}$ (12)
13. $37.5 \overline{) 1.7625}$ (22)
14. Express as common fractions: a. 50%; b. 75%; c. 60%; d. $37\frac{1}{2}\%$. (60)
15. Arrange in order of size, beginning with the smallest: $\frac{5}{8}, \frac{3}{4}, \frac{1}{3}, \frac{1}{2}, \frac{5}{12}, \frac{2}{3}$. (14)
16. Find the interest on \$650 at 3% for 4 months. (106)
17. The interest on \$150 for 1 year is \$6. What is the rate? (108)
18. 145% of \$2400 = ? (65)
19. $350 = ? \% \text{ of } 1400$ (66)
20. An electric toaster was marked at \$16, subject to discounts of 40% and 5%. What was the net cost of the toaster? (80)



CHAPTER VII—INSURANCE

SO YOU'RE GOING TO COLLEGE!

Ruth and Jerry Williams were going to college after finishing high school.

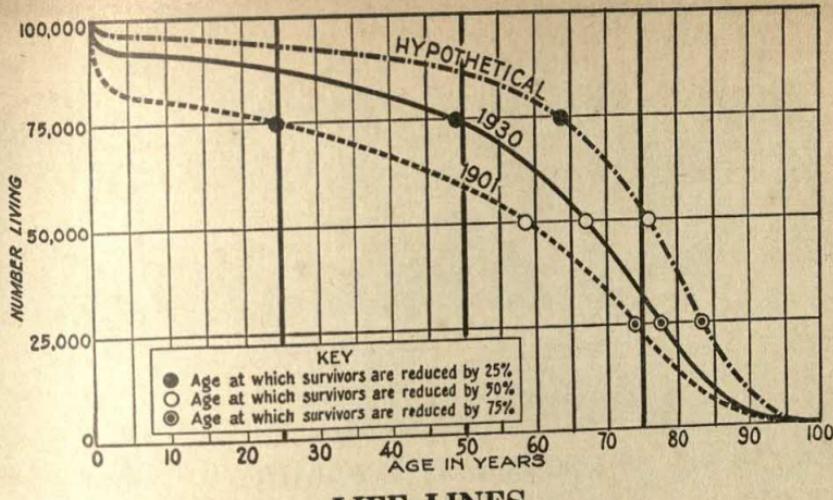
"How much does college cost?" asked Jerry. His father handed him a booklet, "COLLEGE COSTS," issued by an insurance company. According to the booklet, Jerry could get along on \$250 a year at a state agricultural college, but Ruth might spend \$1750 a year at a college for women.

1. What per cent of the women's college charge was the charge at the state school?
2. What was the average of the two costs?
3. At what age do most people enter college? graduate from college? (HINT: Begin school age 6.)
4. Ruth and Jerry's education, Mr. Williams estimated, would cost him about \$4000 for each child. If he began saving when the children were born, how much must he put away each year for 20 years? (Do not consider interest on savings.)
5. But Mr. Williams bought insurance with his savings. He started when each child was born and paid \$387.68 a year for 20 years. He paid in what per cent of what he drew?
6. How much less or more a year did his insurance cost than yearly deposits to his bank account (problem 4)?



SPREAD THE RISK

1. A class in the Rockledge School had a fund for lost books. Dues were 2¢ a week. How much was this a pupil for a term of 36 weeks? How much for a class of 40 pupils?
2. To each pupil in the class was issued a history (\$1.12); a geography (\$1.72); an arithmetic (88¢); a general science (\$1.60); and several English texts (\$1.40). Mary's books were burned. How much was she allowed from the fund?
3. John's history and arithmetic were taken from his locker. How much did the fund pay him?
4. At the close of the school year, \$8.40 remained in the class book fund. How much was due each pupil?
5. What was the cost to each pupil for books lost?
6. How much did Mary save by membership in the fund (problem 2)? John?
7. John's sister, Anna, pays 75¢ a week to the "Health Chest" conducted by the girls in the office where she is employed. How much is this a year?
8. During one year Anna was ill and out of the office for two weeks. The Chest paid her \$10 a week sick benefits. Anna's dues were what per cent of her benefits?
9. Answer "yes" or "no" to the following questions:
 - a. Did the book fund prevent loss of books?
 - b. Did the fund spread the loss among many persons?
10. What do you call any plan that protects against money loss by spreading the risk among many people?



LIFE LINES

1. The graph includes how many newborn babies?
 - a. Of these 100,000 babies how many lived to age 25 under health conditions existing in 1901? What per cent is this?
 - b. How many lived to age 50 under health conditions existing in 1930? What per cent is this?
 - c. How many might have lived to age 65 if our people had followed all the good health rules they know?
2. A fourth of the babies were still living at what age under 1901 conditions? Under 1930 conditions?
3. A fourth of the babies should have lived to what age?
4. Notice that the graph has been divided by bold lines into quarters of 25 years each. In which quarter may we expect the life line to lengthen most?
5. At the time of the Revolutionary War the average life of a person was 30 years; in 1850, 38 years; in 1900, $48\frac{1}{2}$ years; in 1930, $59\frac{1}{2}$ years; nowadays, 62 years. Show these life lines by use of a graph.
- *6. a. Why are our life lines getting longer?
 b. "Longer life lines mean higher insurance premiums." Is this statement true or is it false? Why?



PROTECT THE FAMILY

After Ruth and Jerry Williams had thought through the problem of their college expenses, Ruth asked, "But suppose Father should die?"

"Your \$1000 a year would be paid by the insurance company as if I had lived," said Mr. Williams, joining them unexpectedly.

"How about Mother?" questioned Jerry.

"I have a written agreement with the same insurance company to protect her," replied his father. "I pay \$188 a year. At my death the insurance company pays Mother \$10,000."

1. a. If Mr. Williams paid under this agreement for 20 years, how much more or less would Mrs. Williams receive than her husband had paid? What per cent more or less?

b. How much and what per cent more or less if Mr. Williams paid for 30 years? 40 years?

2. In the business transaction between Mr. Williams and his insurance company, what do you call Mr. Williams? the company? the agreement? Mrs. Williams? \$10,000? \$188?

The following terms answer the above questions. Match question and term. Premium; insurer; policy; beneficiary; insured (or policyholder); face of policy.

3. A company sells to 1000 people, age 25, \$1000 of insurance for each person. If 8 of these people die in one year, how much must the insurance company pay? How much is this for each of the 1000 persons insured?

4. Why is the amount charged each policyholder (problem 3) called the **mortality cost**?

5. Insurance companies have certain costs and expenses of doing business, and they must earn a profit. If these items total \$10,000 a year for the company (problem 3), how much premium must each policyholder pay? (HINT: Mortality cost plus expenses and profits.)

6. "But how long do people live?" queried Jerry. This is answered, in part, by the following mortality table.

EXPECTANCY OF LIFE			EXPECTANCY OF LIFE			EXPECTANCY OF LIFE		
AGE	MALE	FEMALE	AGE	MALE	FEMALE	AGE	MALE	FEMALE
0	60	63	35	34	36	70	9	10
5	60	62	40	29	32	75	7	8
10	55	58	45	25	28	80	5	6
15	51	53	50	22	24	85	4	4
20	46	49	55	18	20	90	3	3
25	42	46	60	15	16	95	2	2
30	38	40	65	12	13			

a. A boy at birth has a fair chance of living to what age? a girl?

b. How much longer may your sister (age 15) expect to live? At what age (as by the table) **may** she die?

c. What will be the average age at death of men and women now 20 years old? 40 years? 60 years?

d. A man 80 years of age can reasonably expect to live how much longer? a woman?

CHOOSE YOUR PROTECTION

1. The following table names 3 kinds of insurance policies. What are they?

AGE	ORDINARY LIFE	20-PAYMENT LIFE	ENDOWMENT	
			20-YEAR	30-YEAR
21	\$15.75	\$22.95	\$44.20	\$27.60
25	17.35	24.95	44.45	27.90
30	19.95	27.80	44.95	28.95
35	23.40	31.40	45.95	30.55
40	28.05	35.95	47.75	33.30
45	34.15	41.70	50.70	37.65
50	42.30	49.00	55.40	44.30

2. One of Mr. Williams' policies is an "ordinary life policy." He bought it at age 25. He must pay the premiums **as long as he lives**. If he dies at age 75, how much will the insurance company have received from him? How much will it pay to his family? (HINT: Life insurance is usually priced at so much a \$1000.)

3. Williams' neighbor has a "20-payment life policy." (He might as easily have bought a "one-payment life" or a "50-payment life," or any other number of years.)

a. If Neighbor took out the policy at age 30, how many payments must he make?

b. How much will he have paid at age 50?

c. How much must he pay (if any amount) during his 51st year? Explain.

d. If he dies at age 32, how much will his family receive? Will the family be required to pay the remaining 18 premiums? Explain.

e. If Neighbor lives beyond age 50, when will his policy become due and payable? Why?

4. Mrs. Williams has a "20-year endowment policy," which she took out at age 21, before she was married.

a. How much is the annual premium on the policy? The total premiums?

b. For how many years must Mrs. Williams pay the premiums (if she lives)?

c. If Mrs. Williams had died at age 24, how much would her family have received? Would the family be required to pay the remaining 17 premiums? Explain.

d. In a year or so Mrs. Williams will be 41 years of age. Will she, at that time, receive \$1000 from her insurance company, or must she "die to win"? Answer the question "Yes" or "No," but be sure to give your reason.
REMEMBER: Endowment means money or property given to a person.

5. Find the yearly premiums on the following policies:

ORDINARY LIFE			20-PAYMENT LIFE			20-YR. ENDOWMENT		
	AGE	AMOUNT OF POLICY		AGE	AMOUNT OF POLICY		AGE	AMOUNT OF POLICY
a.	21	\$7500	d.	25	\$4500	g.	21	\$2500
b.	35	\$4000	e.	30	\$6200	h.	30	\$5500
c.	45	\$6000	f.	35	\$7500	i.	35	\$10000

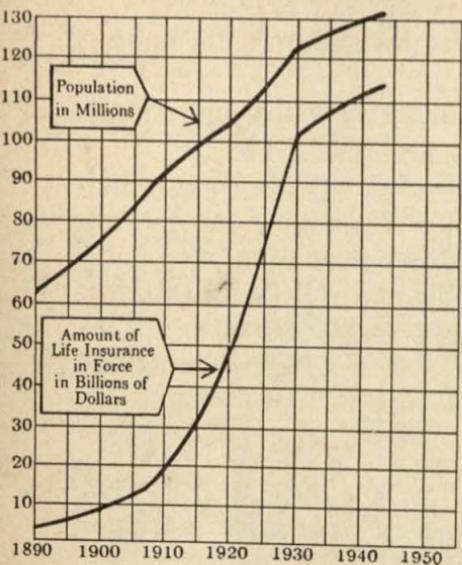
*6. a. Give one advantage and one disadvantage of each type of policy.

b. Which type of policy gives the most protection for the least money?

c. "The older the insured, the more nearly the annual premiums for different kinds of policies are the same." Tell why this quotation is true or is false.

d. At age 21 the premium on an ordinary life policy is what per cent of the 20-payment life premium? At age 50? Why this difference?

LIFE INSURANCE—A GOOD BUY



1. What was the population of the United States in 1890? in 1940 (the year of the last Federal Census)?
2. About how many billion dollars of life insurance did the American people buy in 1890? in 1940?
3. During the fifty-year period our population increased about how many times?
4. The amount of life insurance in force increased about how many times during the same period?
5. During how many of the ten-year periods was there an increase of at least 100% in the life insurance in force?
6. About how much life insurance was in force for each of us in 1900? in 1920? in 1930? in 1940?
7. About what year do you predict the life-insurance line on the graph will cross the population line?
8. How much insurance (on the average) will be in force that year (problem 7) for each person in the United States?
9. About $4\frac{1}{2}$ million life insurance policies are bought in the United States each year. This is one policy for about how many persons?
10. If these policies have a face value of nine billion dollars, how much is that (on the average) for each policy?
11. How does the graph prove that our people rate life insurance very high as an investment?

BUY YOURSELF AN INCOME

1. How much insurance will Mrs. Williams receive on the death of her husband (page 158)?
2. Mrs. Williams may take the \$10,000 as a **lump sum** (all at one time) or as an **annuity** (so much each year). The annuity will pay her \$1128 a year for 10 years. How much more will she receive as an annuity (if she lives for the full time) than as a lump sum? What per cent more?
3. If Mr. Williams wanted an income of \$100 a month at age 65, how much must he have invested at 3%?
4. If he began saving at age 45, how much must he deposit each month? (HINT: Do not include interest on savings.)
5. How long Mr. and Mrs. Williams may expect to live after reaching ages 60 and 65 is shown by the table.

RETIRING AGE	WILL LIVE AFTER RETIRING	
	MALE	FEMALE
60	219 months	261 months
65	180 months	219 months

- a. How many more years will a man live (on the average) who has reached age 60? 65? A woman?
- b. Why does an annuity cost more for a woman than for a man of the same age (See table)?
6. At age 65 Mr. Stanton has \$15,000 invested in $4\frac{1}{2}\%$ bonds. What will his yearly income be from the bonds?
7. If Mr. Stanton, at age 65, should invest \$15,000 in an annuity, his yearly income would be \$1500. How does this compare with the income received from his bonds?
8. At age 60, the average annual income from an annuity is about 8% of its face value for women and 9% for men. If an annuity has a face value of \$15,000, find the average annual income at age 60 for a man; for a woman.

FIRE!

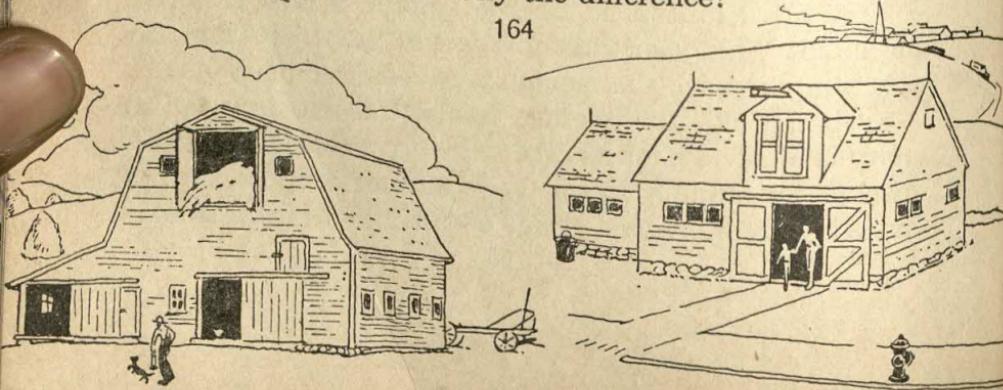
1. In the United States 1360 houses a day (on the average) catch fire and are wholly or partially destroyed. How many is this a year (365 days)?
2. Our total fire loss a year is now about \$300,000,000. How much is this for each person in our country (132,000,000) for your family?
3. The annual fire loss in England is about 72¢ a person; in France, 49¢; in Switzerland, 15¢; and in Holland, 11¢. What per cent of our fire loss a person is the loss in each of the European countries?



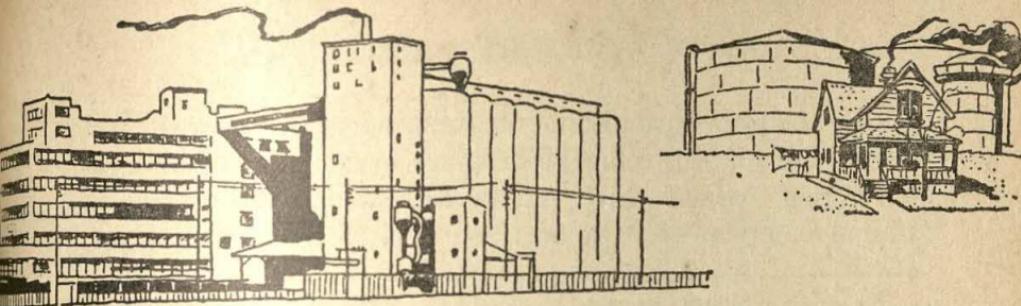
4. Our worst fire-loss year was 1926—\$560,000,000. How much more is this than our present average fire loss? What per cent more?



5. Here are 2 houses. The brick house may be insured against fire at \$.10 for each \$100 of insurance; the frame house at \$.20. How much more does protection cost for frame than for brick? What per cent more? Why the difference?



6. Here are 2 barns. The **up-country** barn can be insured against fire at 78¢ for each \$100 of insurance; the **suburban** (close to city) barn at 70¢. The "suburban" premium is what per cent of the "up-country" premium? Why the difference?

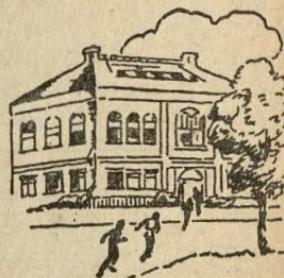


7. This factory can be insured against fire at 60 cents for each \$100 of insurance. What per cent of the "factory" premium is the brick house premium (problem 5)? Why the difference?

8. The "not-so-nice" house near the refinery can be insured against fire at 25 cents for each \$100 of insurance; the playhouse in the park at 10 cents. What per cent of the "not-so-nice" house premium is the playhouse premium? Why the difference?

*9. By solving problems 5-8 you learned that structure, location, use, and surroundings, determine the premium rate in fire insurance. Why?

*10. a. What is a "fireproof" building?
b. Why are all buildings not fireproof?
c. "At home we have a **paid** fire department," said Jerry Williams, "but at the seashore the fire department is a **volunteer** company." What did Jerry mean?
d. "And less fires mean lower insurance premiums," added Mr. Williams. What did he mean?
e. The mayor of the town in which the Williams lived said, "My administration has given you motor-driven fire trucks. The horses are gone. You pay less insurance." What did the mayor mean and why?



PAYING FOR FIRE PROTECTION

Fire insurance premiums on buildings of the same type vary from place to place. There are many reasons for this difference, some of which you have studied (pages 164-165). In one American city the fire insurance rates are as follows:

BRICK HOUSE	FRAME HOUSE
14¢ a \$100	20¢ a \$100
For 3-family apartment houses, add 1¢ to above rates.	
For 4-family apartment houses, add 2¢ to above rates.	
For 5-family apartment houses, add 10¢ to above rates.	
For apartments which house from 6 to 10 families, add 1¢ for each extra family to the cost for a 5-family house.	

1. A one-family brick house is insured for \$7500. What is the annual premium?
2. A 3-family apartment is insured for \$10,000. What is the premium? an 8-family apartment at \$15,000? a 10-family apartment at \$20,000? Why the difference?
3. What is the annual fire insurance premium on a one-family frame house insured for \$3750?
4. The fire insurance premium on the furnishings and other contents of a 5-family apartment is 40¢ for each \$100 of insurance. How much higher is this than the premium on the building? What per cent higher? Why the difference?
5. A large country residence, valued at \$20,000, is insured against fire for \$16,000. What per cent of the valuation is the insurance?
6. A house, recently valued at \$10,000 and insured for \$8000, was burned to the ground—a total loss. The insurance company offered the owner \$6000, the cost of rebuilding the house. The owner sued the company for the full \$8000. What do you think was the result?

BARGAIN RATES

"Buy fire insurance for periods longer than one year and buy it cheaper," is good business, as shown in the table.

PERIOD	RATE
2 years	$1\frac{3}{4}$ times the rate for 1 year.
3 years	$2\frac{1}{2}$ times the rate for 1 year.
4 years	$3\frac{1}{4}$ times the rate for 1 year.
5 years	4 times the rate for 1 year.

1. What per cent may be saved by buying fire insurance for a 5-year period instead of for five 1-year periods? What amount may be saved at an annual rate of 20¢ a \$100?
2. A small dwelling is insured for \$3500 at 15¢ a \$100. (REMEMBER: This is the yearly rate.) How much can be saved over a period of 15 years by buying 3 5-year policies instead of 5 3-year policies? What per cent can be saved?
3. Mr. Russell insures his house each year for \$3600 at 29¢ a \$100. How much could he save during a 5-year period by taking out a 5-year policy?
4. A city turned in its fire trucks for the very latest model fire-fighting apparatus. The new equipment had not been long in use before fire insurance premiums in the community dropped from 14¢ to $12\frac{1}{2}$ ¢ a \$100 on brick dwellings and 19¢ to 18¢ on frame. What was the per cent reduction for brick? for frame?
5. Find the annual savings (problem 4) to an owner of a brick dwelling insured at \$7500; a frame dwelling insured at \$4800.
6. Records of fire insurance companies show that 41.5% of premiums are retained by the company and 58.5% go to fire losses. Show these facts by a circle graph.

1776...1935



1920...1935



388,936

244,357

WAR AND PEACE

During the first World War a soldier, on leave from France, was talking to an assembly in a large city high school. He said, "I hope soon to be out of your city traffic and back to the comparative safety of the trenches." The soldier was jesting, but with much truth.

1. The number of Americans killed in battle, or who died from wounds received in action, is given below:

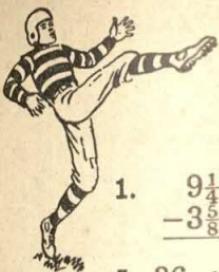
Revolutionary War . . .	4,044	War of the States . . .	184,594
War of 1812	1,956	Spanish-American War .	1,704
War with Mexico . . .	1,549	World War I	50,510

How many Americans were killed or died from wounds received in these wars?

2. How many more lives were lost in America due to automobile accidents during 1920 to 1935 than were lost in all our wars from 1776 to 1935?

*3. To the nearest per cent, the number of lives lost in all of our wars was what per cent of the number killed in our country by automobiles during the same period?

*4. To the nearest per cent, the number killed or who died of wounds in World War I was what part of the total number of lives lost in all our wars?



LET'S PRACTICE

8

Set I

$$1. \begin{array}{r} 9\frac{1}{4} \\ - 3\frac{5}{8} \\ \hline \end{array}$$

$$2. \begin{array}{r} 407 \\ \times 309 \\ \hline \end{array}$$

$$3. \begin{array}{r} 34701 \\ - 18906 \\ \hline \end{array}$$

$$4. 28) \overline{7565}$$

$$5. 36 \div \frac{4}{9} = ? \quad 6. 9\frac{1}{4} \times 3\frac{2}{3} = ? \quad 7. 3\frac{1}{2} \times 15 = ? \quad 8. \begin{array}{r} .145 \\ - .076 \\ \hline \end{array}$$

$$9. \begin{array}{r} 3.8 \\ \times 2.9 \\ \hline \end{array} \quad 10. 2\frac{1}{4} \div 4\frac{1}{2} = ? \quad 11. .04) \overline{16} \quad 12. 2.25) \overline{18}$$

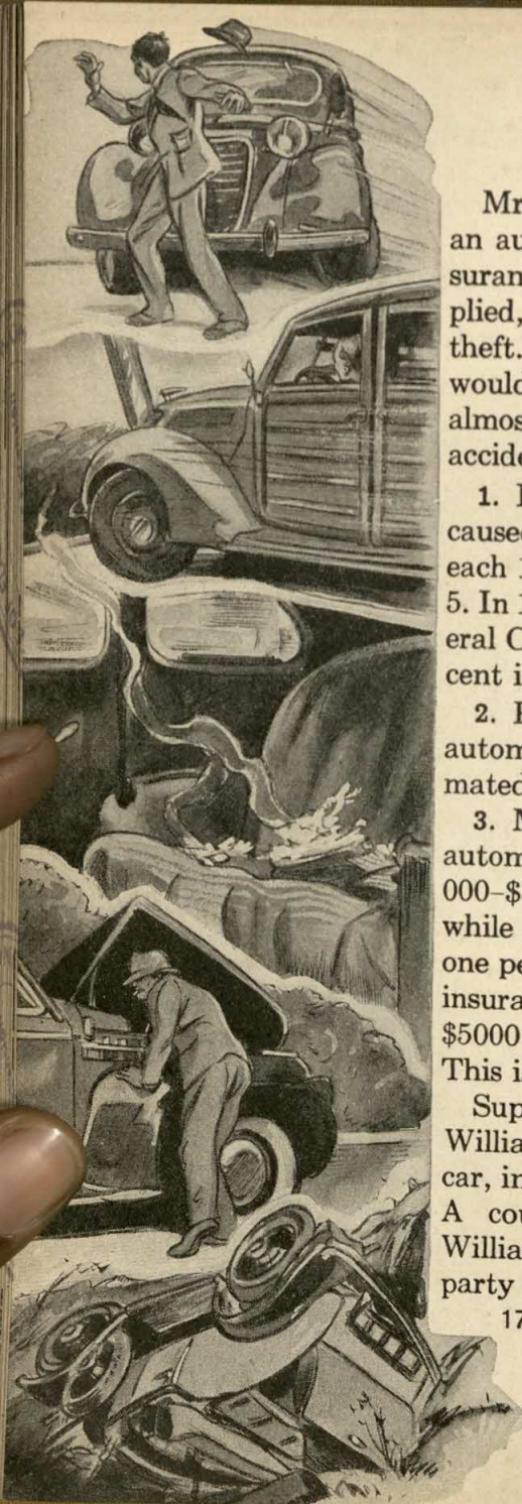
$$13. 736 + 529 + 1728 + 807 + 3259 + 160 = ?$$

$$14. 9 + 4\frac{1}{2} + 3\frac{5}{8} + 6\frac{1}{4} + \frac{7}{8} = ?$$

Set II

Find the missing amounts:

1. 15% of 360 = ?
2. 170% of 400 = ?
3. $\frac{1}{2}\%$ of 1700 = ?
4. $33\frac{1}{3}\%$ of 570 = ?
5. 16 = ? % of 80
6. 75 = ? % of 50
7. 94 = ? % of 94
8. 50 = ? % of 80
9. 12 = 10% of ?
10. 36 = 25% of ?
11. 80 = 150% of ?
12. 300 = 200% of ?
13. 140% of 80 = ?
14. 60 = ? % of 72
15. 72 = ? % of 60
16. 36 = $66\frac{2}{3}\%$ of ?
17. 60 = 120% of ?
18. $\frac{3}{4}\%$ of 1200 = ?
19. 50% more than 48 = ?
20. 25% less than 80 = ?
21. 100% more than 19 = ?
22. 5% less than 50 = ?
23. 90 is 15% of ?
24. .7% of 350 = ?
25. Express the following as per cents: a. $\frac{3}{4}$; b. $\frac{3}{8}$; c. $\frac{2}{3}$; d. 4; e. 1.025; f. .8; g. $1\frac{1}{4}$.
26. Express as decimals to the nearest hundredth: a. $\frac{5}{6}$; b. $\frac{4}{9}$; c. $\frac{7}{8}$; d. $\frac{2}{3}$; e. $\frac{8}{9}$; f. $\frac{7}{16}$; g. $\frac{4}{7}$.



DRIVE CAREFULLY

Mr. Williams owns and drives an automobile. Asked what car insurance he carried, Williams replied, "Liability, property, fire, and theft." Had he added "collision," he would have had protection against almost every kind of automobile accident.

1. In 1914 the number of deaths caused by automobile accidents for each 100,000 of our population was 5. In 1940 (the year of the last Federal Census), 26. What was the percent increase?

2. How many deaths were due to automobile accidents in 1940 (estimated population 132,000,000)?

3. Mr. Williams calls one of his automobile policies a "\$5000-\$10,000-\$5000 policy." If Williams, while driving his car, injures some one person, other than himself, his insurance company will pay up to \$5000; two persons, up to \$10,000. This is **personal liability** insurance.

Suppose, for example, that Jerry Williams, while driving the family car, injured 2 people rather badly. A court of law said that Mr. Williams must pay each injured party \$6000.

How much would Williams' insurance company pay? What per cent of the claim must Mr. Williams pay?

4. Under the \$5000-\$10,000-\$5000 policy Mr. Williams' insurance company must pay up to \$5000 for damage caused by Williams' car to the property of another person. (This is called **property damage**.)

Suppose, for example, that Mrs. Williams, to avoid hitting a kitten on the road, ruins a front hedge of an adjoining property. How much will the insurance company pay? (HINT: You supply the figures for this problem.)



5. The annual premium on Williams' \$5000-\$10,000-\$5000 policy was \$68: \$51 for liability insurance; \$17 for property damage. What per cent of the premium was paid for each type of protection?

6. Williams might have bought a \$10,000-\$20,000-\$5000 policy at a premium 15% higher than the \$5000-\$10,000-\$5000. Find the cost of this larger protection.

7. What is meant by each item in the policy: \$10,000-\$20,000-\$5000?

8. One of Williams' neighbors has a \$10,000-\$20,000-\$5000 policy on his car. He skidded on a wet pavement and crashed into the plate-glass window of a beauty parlor. Two women were hurt by splinters of glass. What is the largest amount for which the company may be liable?

9. The auto insurance company paid the beauty parlor owner \$500 for property damage and settled with each of the injured women for \$1000. What per cent was this of what the company might have had to pay?

*10. Why can you buy twice as much liability protection without doubling the premium?

REWARDS FOR CAREFUL DRIVERS

1. Accidents add about 1¢ a mile to the cost of operating an automobile. If Mr. Average Driver's speedometer registers 7800 miles a year, how much extra do accidents cost? What per cent extra is this if Mr. Average Driver operates his car at 6¢ a mile?

2. Mr. Walters' bill, \$66.15, for liability insurance on his car was only 90% of the amount he had expected to pay. Asked to explain, his insurance company congratulated Walters on safe driving with no accidents during the year. What was the regular premium on Walters' policy?

3. "Drive carefully, avoid accidents, and you will be charged only 85% of our regular rate for your liability insurance," wrote an auto insurance company to its policy-holders. Six owners and drivers took the company's advice and received bills for:

a. \$38.25	b. \$42.25	c. \$27.54
d. \$51.85	e. \$28.90	f. \$22.10

What were the regular premiums?

*4. Find the yearly premium on a \$5000-\$10,000-\$5000 automobile liability policy in your community. What per cent is it of Williams' premium (page 171)?

*5. "You must carry liability insurance," says the law in one of our states. Give one advantage, one disadvantage of such a law. Have you such a law where you live? If so, how much insurance must the car owner carry?

*6. Harold said, "If everybody were required by law to carry liability insurance, drivers would be even more careless than they are now." What do you think?

LOCK YOUR CAR!

1. In 225 American cities, having a total population of about 30,000,000, there were 56,000 automobiles stolen during the last year for which records are available. About how many was this, on the average, for each city?
2. If the same rate held for the United States, about how many cars would be stolen in our country each year (population of U. S. about $4\frac{1}{2}$ times the population of cities given)?
3. What per cent would be stolen? (HINT: The United States has about 30,000,000 automobiles.)
4. In Mr. Williams' community, insurance protection against theft of one's car and fire damage cost a \$100:

KIND OF CAR	FIRE INSURANCE	THEFT INSURANCE
Low-priced car	\$.40	\$ 1.40
Middle-priced car	.30	.85
High-priced car	.25	.75

Williams paid \$950 for a new car. What was his theft premium? fire premium (HINT: Middle-priced car)?

5. If Williams' car had been in the low-priced class, let us say \$625, how much premium would he pay for fire and theft insurance?

6. Williams' insurance company estimates that an automobile loses value at the rate of 2% a month on its purchase price. What was the value of Williams' car after 8 months?

7. If Williams' car were stolen after he had it 8 months and was not recovered, what per cent of its purchase price would the insurance company pay?

8. After Williams had driven his car 18 months, his fire insurance premium increased to 45¢ on each \$100 of valuation. What per cent increase is that? Why the increase?

HOSPITALIZATION INSURANCE

In Mr. Williams' community there is a plan of hospitalization insurance, just as there is in many communities of this country. Mr. Williams' is an easy-payment plan for taking care of hospital expenses when one is ill. Mr. Williams makes regular payments so that he and his family will be protected. In some plans, new members are not accepted if they are over 65 years of age. To all others, the dues each year are about the same as given although the actual dues vary slightly in different parts of the country. Mr. Williams' dues are as follows:

One person.....	\$ 9
Husband and wife.....	18
Husband, wife, and all unmarried children under 19 years of age living at home.....	24

1. At these rates, how much does membership cost the Williams family (Ruth and Jerry are under 19)?
2. What is the average membership fee for each member of the Williams family?
3. The average hospital stay is about 13 days per patient. At this rate, how much is Miss Average Patient's hospital bill at \$5.50 a day?
4. Each member under Mr. Williams' plan is entitled to 21 days free hospital treatment a year (up to \$5.50 a day) and 25% of that amount for an additional 120 days.
 - a. How much more does Miss Average Patient pay than Mr. Williams for the same length of time? What per cent more?
 - b. What is the largest amount any Williams' plan member may receive in hospitalization insurance in any one year?
 - c. How many times Mr. Williams' dues is this? (HINT: Use the \$9 fee.)

5. If Mrs. Williams occupies a hospital bed for 35 days in any one year, how much of her bill will the hospitalization plan pay (assume the hospital room costs \$5.50 a day)? What per cent?

6. If Mrs. Williams chooses an \$8-a-day room, what per cent of her bill must she pay?

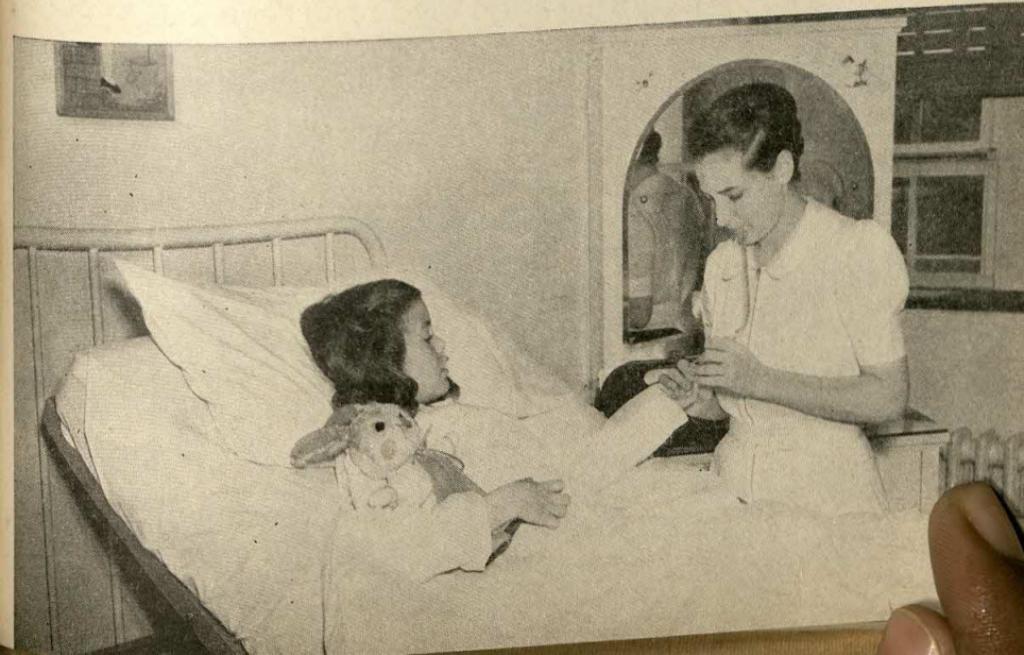
7. Among hospitalization plan members, one in 14 (on the average) received hospital treatment each year. How much more than the hospital bill of Miss Average Patient (problem 3) are the dues of 14 hospital plan members? (HINT: Use the \$9 fee.)

8. "3¢-a-day-plan pays your hospital bills," says the Williams' plan. How much more or less than 3¢ a day do the members pay? (HINT: Use the \$9 fee.)

9. In one American city 45,000 people received hospital care in $2\frac{1}{2}$ years under a hospitalization plan. How many was this (on the average and to the nearest person) a year?

*10. How does the hospital plan in your community differ from the Williams' plan?

*11. Compare hospital room rates today and five years ago. What per cent have they changed, if any?



USING THE VOCABULARY OF ARITHMETIC

Define or use correctly in a sentence each term given below. If you have forgotten the meaning of a term, refer to the key page number in parentheses.

annuity	(163)	limited-payment-life policy	(160)
beneficiary	(158)	mortality table	(159)
easy payment plan	(174)	personal liability	(170)
endowment policy	(161)	policyholder	(158)
face of policy	(158)	premium	(158)
hospitalization	(174)	property insurance	(171)
liability insurance	(170)	straight-life policy	(160)
life expectancy	(159)	theft insurance	(173)

*INFORMATION PLEASE!

1. Select any kind of insurance (not studied in this chapter) for a brief floor talk to your class. Here are three kinds from which to choose. There are dozens of others.
 - a. Marine insurance
 - b. Travelers insurance
 - c. Crop insurance
2. "Our city was rated 'A' by the fire underwriters," said Mr. Williams.
 - a. What is an underwriters association?
 - b. What is an "A" rating and how does it affect insurance premiums?
3. "My insurance dividend this year," said Mrs. Williams, "was \$4.65." What did she mean?
4. "What happens to our insurance premiums?" is a very important question indeed. How would you answer it?
5. What kinds of insurance protection are included under Social Security?
6. What is collision insurance?



HOW WELL DO YOU REMEMBER?



1. Mr. City and Mr. Country drive the same make and age of automobile insured for like amounts. City pays \$44 a year premium; Country, \$32. What per cent more does City pay than Country for the same protection? Why?
2. Mr. Young Man and Mr. Middle Age buy life insurance the same day. Their policies are as alike as can be. Young Man pays \$30 premium a year; Middle Age, \$45. What per cent less does Young Man pay than Middle Age for the same protection? Why?
3. Mr. Roberts pays \$27.35 a \$1000 for life insurance. If he carries a policy of \$12,500, what is his premium?
4. A mortality table gives the death rate at age 25 as 8.065 a 1000. If 12,000 persons, 25 years of age, buy policies, how many deaths, to the nearest whole number, may be expected during the year from this group?
5. If the average death claim is \$1600 (problem 4), what will the death claims total?
6. A house is insured for \$6500 against fire at 54¢ a \$100 for 3 years. What is the premium? the average yearly cost?
7. A new car, costing \$1500, is fully insured against fire at 30¢ a \$100, and theft at 65¢ a \$100. Liability and property damage cost \$58. Find the total premium.
8. Mr. Witt carried no liability insurance on his car. He had an accident which cost him \$6000 to settle. At a yearly premium of \$75, for how many years could he have carried liability insurance with this amount?
9. A member of the Jones family was confined to a hospital for 14 days at an average cost of \$6 a day. The family could have carried hospitalization insurance for \$24 a year. How much could the family have saved by providing hospitalization insurance?

THINGS TO REMEMBER

1. *What is insurance and the different kinds of insurance.*
2. *What things help to determine premiums.*
3. *What is an annuity and how it differs from life insurance.*
4. *How property may be protected against loss by fire or theft.*

TEST ON CHAPTER VII

1. What is one's **expectancy of life?**
2. How is the cost of a life insurance premium affected by the age of the individual when the policy is taken?
3. For any given age, which of the following types of premiums will be highest, and which lowest: ordinary-life, 20-year endowment, or 20-payment life? Why?
4. What is the difference between life insurance and an annuity?
5. Under what conditions would you recommend an annuity?
6. What are some of the things which determine the rate a \$100 for fire insurance on a house?
7. The rate for fire insurance on a house in a certain city is 24¢ a \$100 for 1 year, or 60¢ a \$100 for 3 years. The rate for a 3-year period is how many times the annual rate?
8. A house, valued at \$7500, is insured against fire loss for 80% of its value at 48¢ a \$100 for 3 years. What is the premium? the average cost each year?
9. What is liability insurance? hospitalization insurance?
10. "I have a \$5000-\$10,000-\$5000 liability and property damage policy." Explain the terms of this policy.
11. How is the rate for theft insurance on a car affected by the locality in which the owner lives?

PROGRESS TEST

Solve the problems and perform the indicated operations. If you made errors on this test, turn to the key pages in parentheses, where the work is explained.

1. $11\frac{3}{10} - 6\frac{4}{5} = ?$ (14) 3. $4\frac{1}{4} + 3\frac{5}{8} + 1\frac{1}{2} + 7\frac{3}{4} = ?$ (14)
2. $2\frac{1}{2} \div 2\frac{1}{6} = ?$ (18) 4. $6 \div .8 = ?$ (22)
5. The sum of two numbers is 96.2 and one of the numbers is 38.5. What is the other number? (20)
6. The product of two numbers is 251.25. If one of the numbers is 6.7, what is the other number? (22)
7. $.312 \div 78 = ?$ (22) 8. $2\frac{1}{4} \times 3\frac{1}{7} \times 5 = ?$ (16)
9. Arrange the following decimals in order of size, placing the largest first: .1, .08, .096, .6, .01, .325. (20)
10. 36% of 80 = ? (65) 13. $\frac{1}{2}\%$ of 720 = ? (72)
11. $48 = ?\%$ of 24 (66) 14. $72 = ?\%$ of 360 (66)
12. $10 = 5\%$ of ? (74) 15. $40 = 8\%$ of ? (74)
16. If not over 15 units are to be shown on a bar graph, what would be a convenient scale to use when the largest number to be graphed is: a. 46? b. 110? c. 280? d. 550? e. 2900? (92)
17. The cost of goods to a merchant is 60% of his sales, and the margin 40% of the sales. Show these amounts by a circle graph. (99)
18. At a rate of 35%, find the commission on sales amounting to \$120. (65)
19. Using the formula $i = prt$, find i when $p = \$460$, $r = 3\%$, and $t = \frac{1}{2}$ year. (106)
20. What is the market value of a \$1000 bond sold at $102\frac{3}{4}$? (141)



HOW FEDERAL SPENDING HAS CHANGED

TOTAL APPROPRIATIONS	1930 - \$4,665,000,000 1940 - \$10,529,000,000
 RELIEF	1930 - NONE 1940 - ●●●●●●●●●● \$ 1,755,000,000
 DEFENSE	1930 - ●●●● 1940 - ●●●●●●●●●● \$ 698,000,000 \$ 1,523,000,000
 AGRICULTURE	1930 - ●●● 1940 - ●●●●●●●●●● \$ 453,000,000 \$ 1,272,000,000
 INTEREST ON PUBLIC DEBT	1930 - ●●●● 1940 - ●●●●●●●●●● \$ 659,000,000 \$ 1,000,000,000
 SOCIAL SECURITY	1930 - NONE 1940 - ●●●●●●●●●● \$ 964,000,000
 CCC	1930 - NONE 1940 - ●● each unit represents 200,000,000 dollars \$ 295,000,000

CHAPTER VIII

GOVERNMENT—OUR BIGGEST BUSINESS

The biggest business in the United States is the Government of the United States. It takes in more money (taxes) and pays out more money in wages and service than does any private business or group of private businesses.

One of our great morning newspapers determined to find out just how big was this big business of government. It compared government spending for the Census years 1930 and 1940 and made the picture graph (page 180).

1. How much did the Federal Government spend in 1930? in 1940?
2. The amount in 1940 was about how many times as much as in 1930?
3. Some big items of present-day government expense did not exist in 1930. What are these items?
4. Rank the 1940 items of Federal spending in order of size.
5. How much of the total spent in 1940 is not accounted for on the graph?
6. Give one example of each item of government spending on this graph.
7. In one period of 5 years the appropriations of Congress for this big business of government were: 9 billions; 11 billions; 13 billions; 19 billions; 44 billions. Show these appropriations by use of a vertical bar graph.
8. How much did the appropriation of 44 billions cost each person in the United States? (HINT: population 132,000,000)
9. What evidence on the chart indicates that our big business of government is getting bigger? What effect may this have in "balancing the budget"?



PAYING THE COST OF GOVERNMENT

The pupils of the Glenview School have a "Student Association" which all members of the student body may join and most of them do. Each home room elects one of its number as a representative to the "Student Council" which controls all student activities.

1. The Council adopted and referred to the Association for approval the following budget. What was the total of the estimated expenditures as listed in the budget?

Student Association Budget

Boys' and girls' athletics.....	\$225
Five issues of school paper.....	175
Social functions.....	40
Christmas party.....	25
Club activities.....	100
Bus hired for excursions.....	60
Student handbook.....	50
Total.....	?

2. What per cent of the total spending was allotted to each item in the budget?
3. If the Glenview School enrolled 750 pupils, and 600 were members of the Student Association, what per cent was that?

4. What per cent of the student body was not members of the association?
5. What was the average budget cost a pupil? a member of the Association?
6. The yearly dues, 75¢, of the Student Association were payable 40¢ in September and 35¢ in February. If a pupil wished to pay monthly, the dues were 10¢ a month for 10 months. What per cent could be saved by paying in two instalments?
7. If $\frac{1}{3}$ of the pupils agreed to pay their dues semi-annually and the remainder monthly, what were the estimated yearly receipts from dues?
8. What per cent of the annual budget was raised from dues? from other sources?
9. Pupils, not members of the Association, were charged 25¢ admission to all athletic events. If one of these non-members attended 5 games, how much might he have saved by joining the Association and paying his dues yearly? monthly?
10. What per cent might he have saved by yearly payments? monthly payments?
11. If people in the community began to attend the school games (football, basketball, baseball, soccer) in increasing numbers, admission 50¢, how might this affect the pupils' dues?
12. If the Student Association took on other activities, as, for example, school decoration, how might this affect the budget? the dues?
- *13. If you have a Student Association in the school which you attend, solve problems 1-12 in reference to your local organization.

A CITY BUDGET

The citizens of your community also have an "association." You, and all your neighbors, are "members" even though you may never have "joined." You are taxpayers. You pay money (**taxes**) for the support of government in your neighborhood and in the larger neighborhoods of state and nation.

When you are of age, you will vote for men and women to look after community services such as water supply, public safety, schools. One of the important jobs of these township committees, city councils, county commissioners, or whatever the governing body may be, is to prepare a budget of estimated expenditures. Here is such a budget for a city of 25,000 population.

ITEMS	AMOUNT	PER CENT OF TOTAL
1. Parks and public property	\$ 40,049	?
2. General administration	28,300	?
3. Public works	122,966	?
4. Public safety	98,780	?
5. Health and sanitation	24,440	?
6. Welfare and relief	48,360	?
7. Schools	431,180	?
8. Debt service	388,695	?
9. Miscellaneous	12,480	?
Total	?	

1. What were the total estimated expenditures in this budget?
2. How much was this, on the average, for each person in the city? (Round off budget to \$1,200,000.)

3. What per cent of the total spending was allotted to each item in the budget? (Before working the problem, round off each item to nearest thousand, total budget to \$1,200,000.)

4. What two items combined account for about $\frac{2}{3}$ of the total budget?

5. Make a circle graph showing the amount allotted to the four largest items in the city budget. Put all the remaining items under the heading "Other Expenses."

6. "Debt service" refers to interest which the community must pay on money borrowed, plus something put away each year to pay loans as they come due.

If \$188,695 of the item, "Debt Service" represents interest paid on money borrowed at 3%, on the average, what is the city's debt (answer to nearest \$1000)?

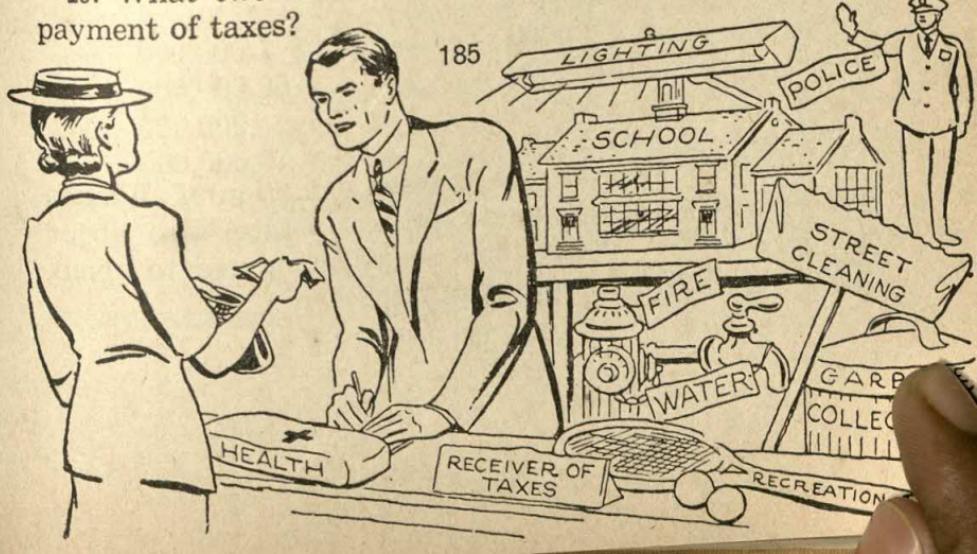
*7. What is meant by each item in the budget other than "debt service"?

*8. How do all citizens profit by each item in the budget?

*9. Do you have a private watchman for your home? "Certainly not," you say, but householders used to employ watchmen. Can police protection, fire prevention, and other community services be bought more cheaply by citizens as a group through taxes or by individuals privately?

*10. What two reasons, therefore, can you offer for the payment of taxes?

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THE TAX RATE

1. "This house," said Mr. Scott to John, "is worth \$10,000; I would not take a cent less; and taxes aren't bad — $2\frac{1}{2}\%$ a year, or \$150." John figured the taxes and decided that his father was wrong. What do you think?

2. "\$150 is correct," continued Mr. Scott. "You figured on the price at which I am holding the house. But I pay taxes only on \$6000, the value placed on the property for tax purposes (assessed valuation) by the city." Prove that Mr. Scott's tax bill is correct.

3. Use the Scott house as a sample and tell whether property usually is assessed at its true value; less than its true value; more than its true value.

4. How much must be raised by taxation in the city of 25,000 population (page 184)? If the assessed valuation of all property were \$32,341,000, what was the tax rate?

$$\$1,195,250 \div \$32,341,000 = .0369 = 3.69\%$$

The tax rate is 3.69% on \$1; or 3.69¢ on \$1.

RULE: To find a tax rate, divide the amount to be raised by the total assessed valuation.

5. Find the tax rate for the following:

	TO BE RAISED	ASSESSED VALUATION
a.	\$ 25,000	\$ 1,000,000
b.	1,000,000	50,000,000
c.	40,000	900,000
*d.	125,450	10,600,000

6. In our largest city the assessed valuation of all lands and buildings (real property or real estate) was about \$17,000,000,000. If the taxes levied amounted to about \$500,000,000, what was the tax rate?

EXPRESSING THE TAX RATE

Tax rates are usually expressed as so many mills on a dollar of assessed valuation (a mill is $\frac{1}{10}$ ¢); as so many dollars and cents on \$100 of assessed valuation; as so many dollars and cents on \$1000 of assessed valuation.

1. A tax rate is \$2.58 on \$100 of assessed valuation. How many mills on the dollar is this rate? How many dollars and cents on \$1000?

\$2.58 on \$100 is the same as 2.58¢ on \$1.

2.58×10 (mills in a cent) = 25.8 mills.

Thus, the tax rate may be written as 25.8 mills on \$1 of assessed valuation.

If the tax rate is \$2.58 for \$100 of assessed valuation, for \$1000 it will be ten times as much, or \$25.80.

2. How many mills are there in one dollar?
3. Express the following tax rates in mills on \$1: a. \$3.02 on \$100; b. \$19.31 on \$1000; c. \$2 on \$100.
4. Express the following tax rates in dollars and cents on \$1000: a. \$1.80 on \$100; b. 24.3 mills on \$1; c. 3.40 mills on \$1.
5. Express the following tax rates in dollars and cents on \$100: a. \$43.20 on \$1000; b. \$9.07 on \$1000.
- *6. The school tax in a certain state is known as the "2.75 mill tax." Express this tax on the basis of each \$100 of valuation; each \$1000.
- *7. How much school tax (problem 6) would be paid by a man whose property is assessed at \$4600?
- *8. A city fixed its tax rate at \$1.70 per \$100 valuation for city purposes, plus \$1.17 $\frac{1}{2}$ for schools. An owner of two houses, assessed at \$5000 and \$3500, paid how much tax?

PROPERTY TAX

1. Mr. Dixon owns property assessed at \$4600. If the tax rate is \$3.18 on \$100, what tax does he pay?
2. If Mr. Dixon pays his taxes (problem 1) in equal quarterly instalments, what is the amount of each instalment?
3. A city allows a discount of 2% on taxes paid in full on or before January 15 of any given tax year. If Mr. Green owns property assessed at \$5400, and the city tax rate is \$3.40 on \$100, how much does he save by payment January 13?
4. A penalty of 8% was charged for failure to pay taxes when due. If Mr. Clayton's quarterly tax was \$60, and he was 12 days late in paying one instalment, how much penalty had he to pay?
5. Mrs. Allen's property is assessed at \$8400. Her school tax is 8 mills on \$1. How much is her yearly school tax?
6. In one American city taxes are payable October 1 and April 1. A discount of 4% is allowed on the second half-year's tax if paid when the first half is due and paid. The tax rate is \$2.82 a \$100 of assessed valuation. If I own a house, assessed at \$10,000 in that city, and I pay my taxes in full October 1, how much do I pay?
7. The assessed valuations on Mr. Moore's two houses are \$16,500 and \$12,450. The school tax rate is 12.8 mills on \$1. How much is his total yearly school tax?
8. Find the amount of property tax on the following:

ASSESSED VALUATION	RATE A \$100	ASSESSED VALUATION	RATE A \$100
a. \$4650	\$2.40	d. \$2125	\$1.80
b. 3200	2.57	e. 5460	2.95
c. 6250	3.10	f. 3550	2.18

TOTAL WEALTH

REAL ESTATE

ALL OTHER



GOVERNMENT COSTS

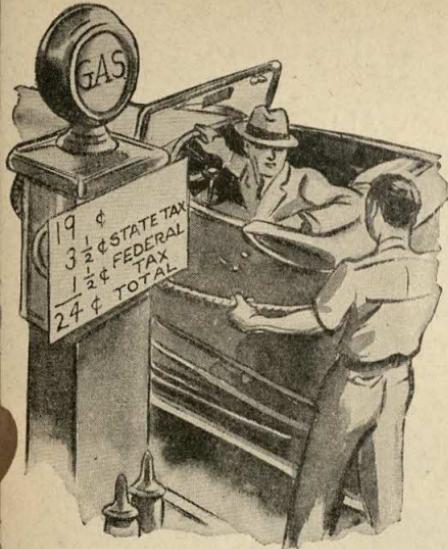


SCHOOL COSTS



*REAL ESTATE BEARS A HEAVY BURDEN

1. In the graph our "total wealth" comes from what two sources?
2. What are some things that might be included under "all other wealth"?
3. In the graph, how many disks are used to represent "total wealth"? How many disks represent "government costs"? How many disks represent "school costs"?
4. What per cent does each circle or disc represent?
5. Real estate represents what per cent of total wealth, according to the graph?
6. About what per cent of the costs of government is paid by taxes from real estate?
7. About what per cent of the costs of schools is paid by taxes from real estate?
8. If taxes on real property are high, people hesitate to buy homes. Why is this true?
9. Authorities on taxation state that the tax base should be broadened. What does this mean?
10. What are some ways of broadening the tax base?
11. If the tax base were broadened, how should that affect the rate of tax on real property?



THE MOTOR FUEL TAX

1. Over a billion dollars a year are collected in the United States from gasoline taxes. The larger part goes to the states; the remainder to the Federal Government.

a. What is the state tax on motor fuel in your community? the Federal tax?

b. The combined tax is what per cent of the service-station price of gasoline?

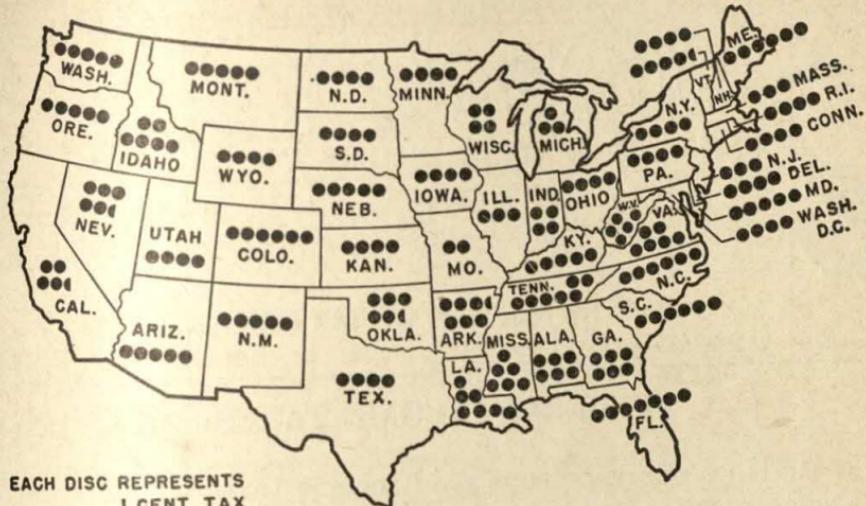
2. If Mr. Average Motorist pays \$37.30 a year in gasoline taxes, and the average tax is 5¢ a gallon, how many gallons of gasoline does Mr. Average Motorist buy a year?

3. Find the yearly cost of gasoline at 17¢ a gallon to Mr. Average Motorist (problem 2).

4. "\$1.00 buys 5 gallons (tax included)" blazoned a roadside service station sign. If the state tax was 5¢ a gallon and the Federal tax 1½¢, the combined tax was what per cent of the sales price of the motor fuel?

5. For the privilege of operating automobiles, owners pay about \$1 of every \$8 collected in taxes by state governments. What per cent of the total tax collections is this?

*6. Each dollar spent for gasoline in this country is distributed about as follows: taxes, 32¢; labor, 29¢; service stations, 11¢; refineries and oil companies, 28¢. Show these amounts by a circle graph.

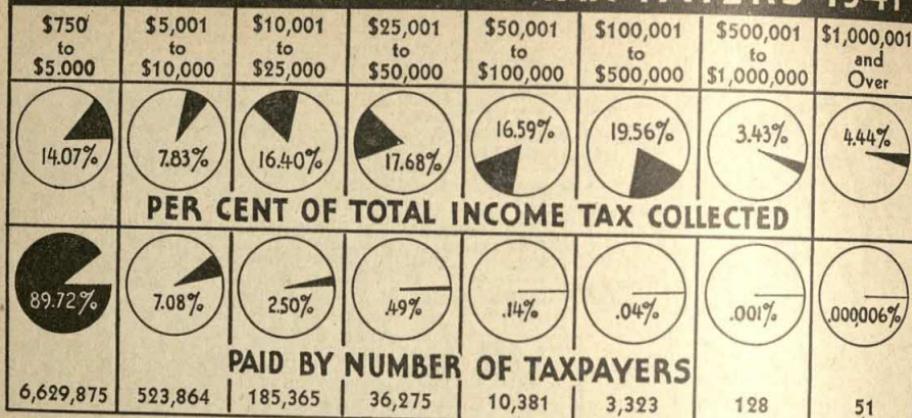


STATE GASOLINE TAX RATES

1. Check the map graph to see whether the rate as shown is the present tax in your state.
2. What three states had a 7-cent state tax on gasoline?
3. What state had a 2-cent state tax on gasoline?
4. In the following table you are given the amount of motor fuel used in a year by 6 states and by the United States. Copy the table and insert the amounts received from the state motor vehicle tax and from the Federal tax.

	GASOLINE USED	STATE TAX	FEDERAL TAX
Maine	150,000,000 gal.	\$?	\$?
Florida	365,000,000 "	?	?
Minnesota	560,000,000 "	?	?
Texas	1,340,000,000 "	?	?
Washington	355,000,000 "	?	?
California	1,850,000,000 "	?	?
United States	22,700,000,000 "	?	?

THE ARMY OF INCOME TAX PAYERS-1941



FEDERAL INCOME TAXES

1. How many persons paid income taxes for the year shown on the graph?
2. Which income group paid the greatest per cent of the total income tax? the smallest per cent?
3. The one group of taxpayers (problem 2) numbers how many times as large as the other group?
4. How many taxpayers are included in the groups with incomes up to \$50,000 a year?
5. What per cent of the total income tax do these 4 groups (problem 4) pay?
6. How many taxpayers are in the groups with incomes of \$50,000 or more?
7. What per cent of the total income tax do these 4 groups (problem 6) pay?
- *8. Income taxes are based on "ability to pay." What does "ability to pay" mean?
- *9. How does the graph show that income taxes are based on ability to pay?
- *10. How much of a single person's income is exempt from income tax? of a head of a family with 2 dependent children?

STATE INCOME TAXES

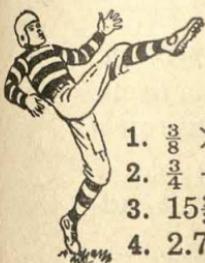
In one of our states the tax rates on **net income** (total income less deductions and exemptions) are as follows:

2% on the 1st \$1000
3% on the 2nd and 3rd \$1000
4% on the 4th and 5th \$1000
5% on the 6th and 7th \$1000
6% on the 8th and 9th \$1000
7% on all over \$9000

1. Using the rates given, find the state income tax on a net income of \$3600.

2% of \$1000 = ?, the tax on the 1st \$1000
3% of \$2000 = ?, the tax on the 2nd and 3rd \$1000
4% of \$600 = ?, the tax on the amount above \$3000
? + ? + ? = ?, the total tax.

2. Sally said, "The income (problem 1) was \$3600. I think, therefore, that the income tax should be 4% of \$3600, or \$144." Show why her reasoning was incorrect.
3. Using the rates given, find the income tax on the following net incomes: a. \$950; b. \$1475; c. \$2440; d. \$3175; e. \$6220; f. \$11,500; g. \$14,275.
4. A man has a total income of \$5500. His exemptions amount to \$3200. Find his state income tax.



LET'S PRACTICE

$$1. \frac{3}{8} \times 42 = ?$$

a

$$2. \frac{3}{4} \div \frac{7}{8} = ?$$

$$3. 15\frac{2}{3} - 8\frac{5}{6} = ?$$

$$4. 2.7 \div .03 = ?$$

$$5\frac{1}{2} \times 36 = ?$$

b

$$12\frac{1}{2} \div 9 = ?$$

$$36 \div \frac{4}{9} = ?$$

$$.473 - .198 = ?$$

$$11\frac{1}{4} - 7\frac{5}{8} = ?$$

$$6\frac{1}{2} + \frac{3}{4} + \frac{5}{6} = ?$$

$$9.5 \times 4.3 = ?$$

$$.51 \div .017 = ?$$



INTERNAL REVENUE

1. A news item read, "Internal revenues this year top six billions." You paid some of this tax every time you went to the movies or bought chewing gum. Older persons paid in the form of income taxes and taxes on gasoline, liquors, tobacco, radio sets, and dozens of other articles. How much, on the average, was paid (to the nearest 10¢) by each person in the United States (population 132,000,000)?
2. Certain brands of cigarettes were sold at two packages for 27¢. The internal revenue tax on each package was 6¢. What per cent of the selling price was the tax?
3. A carton of 10 packages of cigarettes was taxed 58¢. If the carton sold for \$1.20, the tax was what per cent of the sales price?
4. A box of cigars sold for \$2.40. This price included a tax of 40¢. What per cent of the selling price was the tax?
5. A box containing two decks of playing cards sold for 43¢. This included an internal revenue tax of 10¢ on each deck. The tax was what per cent of the sales price?
6. If telephone calls costing \$1.00 to \$1.99 are taxed 10¢ each; \$2.00 or more, 20¢ each, is the rate of tax the same on each of the two groups? What is the rate of tax on a call which costs \$1.15? \$2.25?
- *7. Find the rate of tax on: a. telegraph messages; b. admission to school athletic events; c. club dues.

TARIFFS AND CUSTOMS

In one year, 1927, the United States received \$600,-000,000 from **customs** (or **customs duties**). This is the largest amount ever paid our government in any one year in the form of **taxes on goods brought in from foreign countries**.

1. In that year our imports were valued at four billions of dollars. What per cent of this was customs duties?
2. About 60% of these imports, by value, were **on the free list**. They paid no duty or **tariff**. What was the value of the goods admitted free?
3. What was the average per cent tax on **dutiable** goods (goods not admitted free)? (HINT: Divide customs receipts by value of imports – free goods.)
4. An oriental rug, valued at \$600, pays a duty of 50%. What is the duty? (This is called an **ad valorem** duty because it is based on price.)
5. Woolen yarn of a certain quality brought into the United States pays a tax of 60¢ a pound. This is a **specific** duty (so much a pound). If a manufacturer used 1000 pounds of this wool a year, how much would he save if this quality yarn were placed on the free list?
6. Find the per cent duty on tobacco valued at \$36,000,000; duty, \$24,000,000.
- *7. A tariff is sometimes spoken of as a "tariff wall." What does this mean?



WHO PAYS TAXES?

1. Lloyd French, a householder, pays \$60 a month rent. The owner of the property pays \$200 a year local real estate tax. What per cent of the monthly rent goes for taxes?
2. French bought a hat, imported from London, and priced at \$12.50. This included a duty of \$3.00. What per cent of the selling price of the hat was the duty?
3. His income, subject to the normal income tax, was \$1500. He paid \$60 in taxes. What per cent was this?
4. French bought gasoline for his car, 30 gallons a month at 19¢ a gallon on the average. If his state tax was 4¢ and the Federal tax, $1\frac{1}{2}$ ¢ a gallon, how much did he pay in gasoline taxes a year?
5. Mr. French paid a \$200 a year premium on his life insurance. \$6 of this went to the United States Government in the form of taxes. What per cent of the premium was the tax?
6. His radio-phonograph cost \$60, on which the manufacturer paid a tax of \$6. What per cent was this?
7. In problems 1-6 which taxes are **direct** taxes (paid directly by Mr. French)?
8. Which taxes are **indirect** (paid by some party other than Mr. French and hidden in the price of the goods)?
9. Which of the two kind of taxes, **direct** or **indirect**, does Mr. French probably pay more cheerfully?
10. The community in which Mr. French lives had a town meeting. Mr. Milton, a neighbor of Mr. French, stood up. "No one should be permitted to speak at this meeting except property owners, because they pay our taxes," said he. What reply would you have made to Mr. Milton?

TAXATION

1. In 1940 about one out of every six wage earners was government-employed and paid from public funds. What per cent was this? If our wage earning population at the time was 53,000,000, to the nearest million, how many were government-employed?

2. If the average annual pay of a government employee was \$1500, what was the total annual wage of the government workers in Problem 1? How much was the average contribution of each of the country's 132,000,000 citizens to annual government wages?

3. The cost of government usually takes about one fourth of our national income. If the national income for a certain year was \$161,000,000,000, what amount was used for the cost of government?

4. When the national debt is 125 billions what is each person's share when the population is 132 million? (Answer to nearest \$10.)

5. If the interest rate on the debt in Problem 4 averages 2% a year, what is your share of the annual interest? Your family's share?

6. A magazine of national circulation counted the number of local districts in our country that levied and collected taxes from its citizens. Here is the list:

3,062 counties	128,548 school districts
16,659 cities, towns, villages, and boroughs	19,769 townships 14,573 minor civil divisions

a. How many tax districts were there in all?

b. To the nearest whole number, what was the average number of local tax districts in each state?

*7. In your locality, what taxes are deducted by the employer from the wage-earner's salary?

Why is the employer required to make these deductions?

USING THE VOCABULARY OF ARITHMETIC

Define each of the following terms or use it correctly in a sentence. If you do not know the meaning of a term, turn to the key page in parentheses.

ad valorem duty	(195)	indirect taxation	(196)
assessed valuation	(186)	internal revenue	(194)
budget	(182)	mill	(187)
customs duties	(195)	net income	(193)
direct taxation	(196)	property tax	(186)
dutiable goods	(195)	real estate	(186)
exemption	(192)	specific duty	(195)
free list	(195)	tariff	(195)
import duty	(195)	tax rate	(186)
income tax	(192)	taxpayer	(184)

*TOPICS FOR SPECIAL REPORTS

1. "Nuisance taxes."
2. Free trade—advantages and disadvantages.
3. The budget of our local government.
4. What I get for my taxes from Uncle Sam, my state, my community.
5. The national debt.
6. Taxes should be based on ability to pay.
7. Taxes should be based on benefits derived.
8. Taxes (at least 3) for the support of our local community.
9. Taxes (at least 3) for the support of our state government.
10. Taxes (at least 3) for the support of our national government.

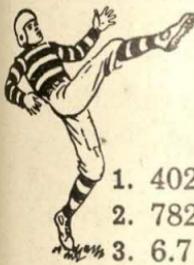
MAGIC SQUARES

Draw three squares each containing 16 cells. Copy the numbers given and then find the missing numbers in each magic square.

13	?	?	23
?	22	14	9
21	?	12	15
11	16	?	6

$1\frac{1}{3}$	$\frac{1}{6}$	$\frac{1}{4}$?
$\frac{5}{12}$	?	$\frac{5}{6}$	$\frac{2}{3}$
$\frac{3}{4}$	?	$\frac{1}{2}$?
$\frac{1}{3}$	$1\frac{1}{6}$	$1\frac{1}{4}$?

8.0	?	1.5	6.5
2.5	5.5	?	?
4.5	3.5	?	6.0
2.0	?	7.5	0.5



LET'S PRACTICE

Set I

a

b

c

1. $4020 - 2026 = ?$	2. $14 \times 4\frac{5}{6} = ?$	3. $3 \div 2\frac{1}{2} = ?$
2. $7826 \div 18 = ?$	$4\frac{1}{6} - 2\frac{2}{3} = ?$	$5\frac{1}{2} \times 4\frac{3}{4} = ?$
3. $6.7 \times 30.8 = ?$	$319.2 \div .38 = ?$	$16.05 - 9.95 = ?$
4. $9\frac{3}{4} \div 12\frac{3}{8} = ?$	$21\frac{3}{8} \times 12 = ?$	$16 \div \frac{8}{9} = ?$
5. $9\frac{3}{8} + 7\frac{1}{2} + 12\frac{3}{4} + 11\frac{7}{8} + 15 + 6\frac{1}{4} = ?$		
6. $.738 + .095 + .600 + .498 + .675 + .846 = ?$		

10

Set II

a

b

c

1. 3% of 145 = ?	2. $\frac{1}{2}\%$ of 480 = ?	175% of 54 = ?
2. $12 = ?\%$ of 48	$60 = ?\%$ of 24	$96 = ?\%$ of 480
3. $8 = 4\%$ of ?	$24 = 20\%$ of ?	$36 = 150\%$ of ?
4. 103% of 750 = ?	$27 = ?\%$ of 18	$30 = 15\%$ of ?
5. 75% more than 60 = ?	90% less than 150 = ?	1% more than 200 = ?
6. $\frac{1}{2}\%$ of 940 = ?	100% of 7.5 = ?	1.6% of 55 = ?



HOW WELL DO YOU REMEMBER?



1. In 1900 the per capita debt in the United States was \$40; in 1940 (the year of the last Federal Census), \$450.
 - a. The debt in 1940 was how many times as much as in 1900?
 - b. How much was the debt in 1940 (assume the population at 132,000,000)?
2. If the average state tax on gasoline is 4.46¢ a gallon, how much tax will Mr. Average Motorist pay if he gets 15 miles to the gallon and drives 7500 miles?
3. About 25.3¢ of each rent dollar represents hidden taxes. If the Jones family pays \$60 a month rent, how much hidden tax do they pay in a month? in a year?
4. Ten years ago state highway funds received about 71% of all state gasoline taxes; today, about 42%. Show these facts by 2 circle graphs.
5. A farm neighborhood of 400 people had property assessed at \$200,000. If the expenses of local government averaged \$5000 a year, what was the tax rate in mills on a dollar? in dollars on each \$100 of assessed valuation?
6. In one American city the tax rate for schools is \$1.17 $\frac{1}{2}$ for each \$100 of assessed valuation. A manufacturer in that city has a factory assessed at \$250,000. How much school tax does he pay?
7. The budget of that city for one year was \$80,000,000. 40 (millions) of this came from real estate; one from amusements; 10 from water rents; 20 from wage tax; and the remainder from several other taxes.
 - a. Show these figures by a circle graph.
 - b. What per cent of the tax burden did real estate carry?

THINGS TO REMEMBER

1. How a tax rate is determined.
2. How to express a tax rate.
3. Types of local, state, and Federal taxes.
4. The difference between direct and indirect taxes.

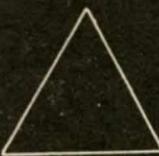
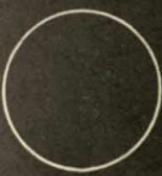
TEST ON CHAPTER VIII

1. A tax rate of 23.4 mills on \$1 of assessed valuation is how many dollars on \$100 of assessed valuation? on \$1000?
2. A school tax rate is 12 mills on \$1 of assessed valuation. Find the amount of school taxes which a man will pay whose property is assessed at \$4600.
3. Mr. Hanson paid \$9500 for his property. It is assessed at 60% of this value. Find his yearly tax if the rate is \$2.87 on \$100 of assessed valuation.
4. Mr. Fisher has a net income of \$3000 on which he pays a normal income tax of 4%. Find the amount of his tax.
5. Certain college students decided to pay one fourth of their purchases in pennies. These pennies, so they claimed, represent the hidden tax on the article. If a student bought a suit of clothes for \$36, what was the hidden tax?
6. The price of gasoline, posted at a gasoline station, was: gas, 11.6¢; state tax, 4¢; Federal tax, $1\frac{1}{2}$ ¢. What was the total cost of the gasoline a gallon? To the nearest tenth per cent, the tax was what per cent of the selling price?
7. If a motorist drives 9600 miles in one year and averages 12 miles to a gallon of gasoline, find the gasoline tax he paid at the rate of 5¢ a gallon.
8. Tickets to a professional football game averaged \$1.00 each plus a tax of 10%. What was the total tax on a sale of 12,840 tickets?

PROGRESS TEST

Solve the following problems. Then have your paper scored. If you made errors, turn to the key page in parentheses where the work is illustrated and explained.

1. In a high school 876 pupils spent \$27,000 for "sweets" in one school year. To the nearest cent, what was the average amount spent for sweets by each pupil? (27)
2. Find the area of a square having a perimeter of 24 inches. (38)
3. The side of an equilateral triangle is 8 feet and its altitude is 6.9 feet. What is the area of the triangle? (40)
4. A one-way bus ticket cost 40¢, or 65¢ a round trip. What per cent of the cost of two one-way tickets may be saved by buying a round-trip ticket? (82)
5. An agent earned \$27.20 a week (on the average) selling toilet articles. If his commission was 40%, what were his average weekly sales? (74)
6. An electric washing machine sold for \$65 cash, or \$5 down and \$8 a month for 8 months. What was the interest charge for instalment buying? (110)
7. To the nearest cent, find the proceeds on a note of \$650, discounted at 6% for 62 days. (117)
8. How many days are in the interval from June 15 to August 15? (119)
9. A property, worth \$4800, is mortgaged at 60% of its value. Find the amount of the mortgage. Find the yearly interest on the mortgage at $5\frac{1}{2}\%$. (135)
10. Mrs. Barton bought 100 shares of stock at $57\frac{3}{4}$; commission, $17\frac{1}{2}\%$ a share. Find the cost of the stock including the commission. (147)



CHAPTER IX GEOMETRIC FIGURES

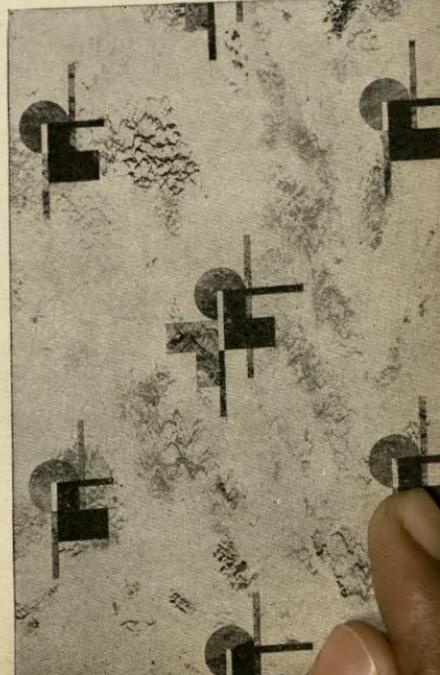
1. The margin of this page contains regular geometric figures which you will recognize at sight. Name each figure.

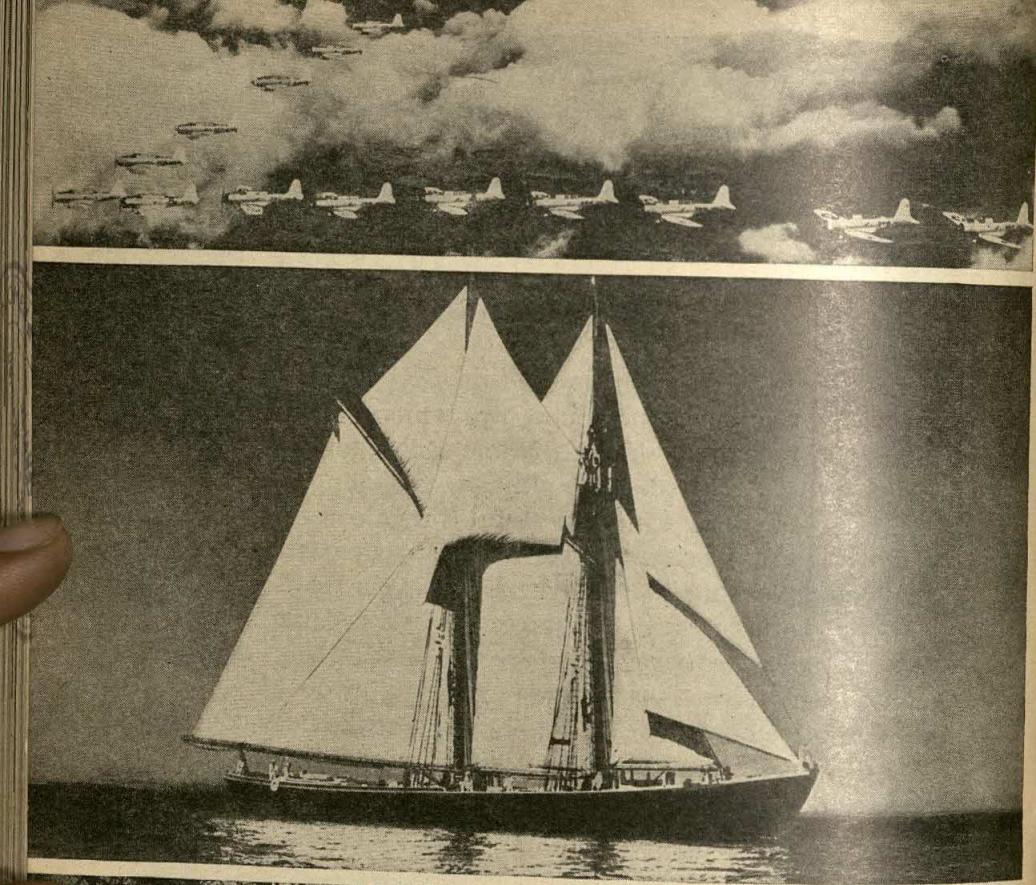
Architects of buildings, and designers of many kinds of useful things combine these simple figures into patterns pleasing to the eye. You never, for example, saw a square house with square windows and square doors. People dislike this sameness. They demand at least a few rectangles for openings.

2. Notice how pleasing is the design of the floor covering. Name each geometric figure which you recognize in this pattern.

3. Plan a "geometric figure hunt" similar to the "scavenger hunts" of which you are so fond. Bring in examples of not less than 12 geometric figures used in designs. (HINTS: clothing, furniture, buildings, objects in nature, jewelry.)

*4. Plato, a Greek, and one of the most learned men of all time, said, "God eternally geometrizes." What did Plato mean?



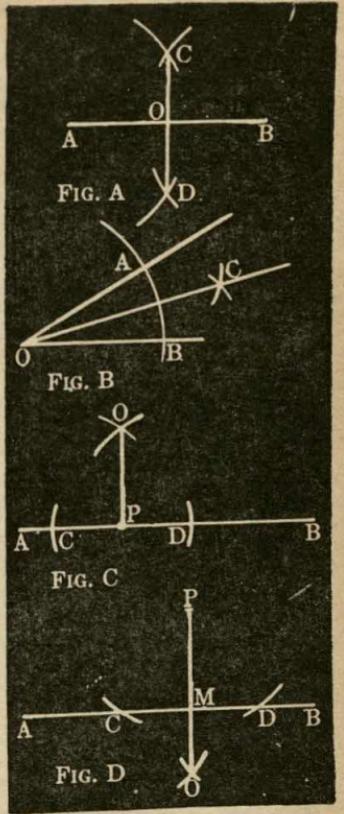


GEOMETRY: AIR-SEA-LAND

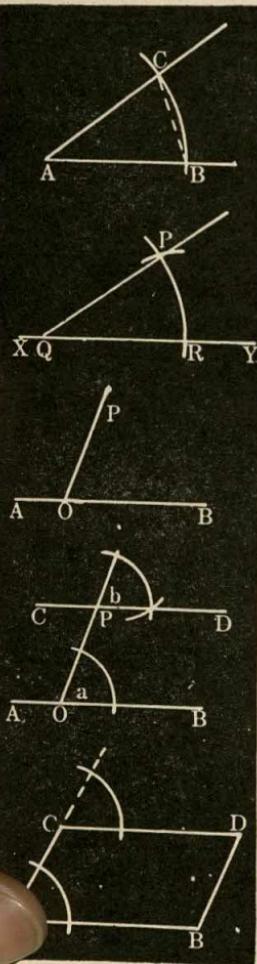
SEGMENTS—ANGLES— BISECTORS—PERPENDICULARS

You have learned how to bisect a line (Fig. A); how to bisect an angle (Fig. B); and how to construct a perpendicular from a point on a line (Fig. C).

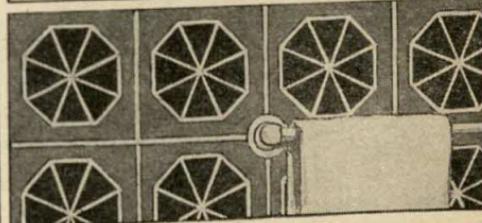
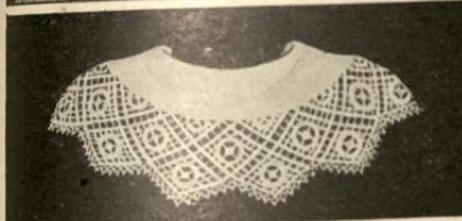
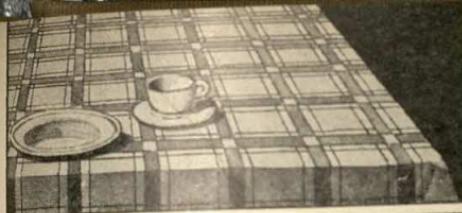
1. Tell briefly:
 - a. What **bisect** means.
 - b. What a **segment** of a line is.
 - c. Whether a line is of **definite** or **indefinite** length.
 - d. When two lines are **perpendicular** to each other.
 - e. How to bisect a line.
 - f. How to bisect an angle.
 - g. How to erect a perpendicular.
2. Draw a line 5 inches long and bisect it. Test the accuracy of your construction with your compasses.
3. Draw an angle of 50° and bisect it. Test the accuracy of your construction with your protractor.
4. How can you divide a line or an angle into 4 equal parts?
5. Draw a line, AB , 3 inches in length. At a point, 1 inch from A , erect a perpendicular. How many degrees are in each angle at A ? Measure each angle with a protractor.
6. Figure D shows the construction of a perpendicular to a line from a point outside the line. Tell each step in the construction.
7. From a point, P , outside a line, AB , construct a perpendicular to the line.
- *8. Draw an isosceles triangle and bisect the base. The bisector should also bisect the vertex. Prove that it does.



PARALLEL LINES—HOW CONSTRUCTED

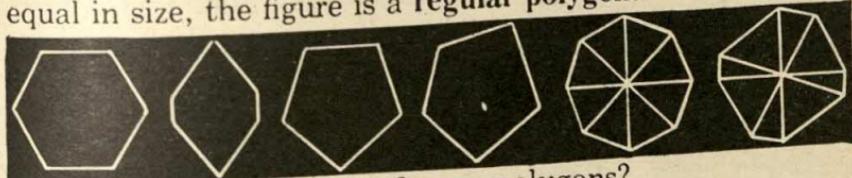


1. One of your important jobs this school year is to prove that you can construct a line parallel to a given line. When are two lines said to be **parallel**?
2. Your first task is to construct an angle, PQR , equal to another angle, CAB (\angle is the symbol for angle).
 - a. Tell how $\angle PQR$ was constructed.
 - b. Draw any angle. Construct another angle equal to it.
3. Your second task is to construct a line at point, P , parallel to AB . The given line is AB .
 - a. Draw a line from O through P .
 - b. Construct at point, P , angle b equal to angle a .
 - c. The side of this angle CD is parallel to AB .
 - d. Draw any straight line. Construct another line parallel to it. Check with your ruler or by dots on paper to find whether the two lines are equally distant at all points.
4. Draw an angle of 40° . With ruler and compasses, construct an angle of 40° . Test the accuracy of your construction with your protractor.
- *5. Draw lines AB and AC of any length. At C construct a line parallel to AB . Mark point, D , on this line at the same distance from C that B is from A . Join DB . What kind of geometric figure have you constructed?



BUSINESS USES GEOMETRY

1. On this page are designs for table oilcloth, floor linoleum, embroidery, and bathroom tile. Martha noted the geometric figures in each design and remarked, "Business also eternally geometrizes." What did she mean?
2. Name each geometric figure in these designs.
3. Choose one of the simpler designs illustrated and construct it; or choose a design used in the furnishings of your home.
4. a. How many sides has a square?
b. Are the sides equal or unequal in length?
c. Are the 4 angles equal or unequal?
5. Any plane figure bounded by straight lines is a **polygon**. If the sides are of equal length and the angles are equal in size, the figure is a **regular polygon**.



- a. Why are all these figures polygons?
b. Which figure is a regular pentagon? How many equal sides? equal angles?
c. A regular hexagon? How many equal sides? angles?
d. A regular octagon? How many equal sides? angles?

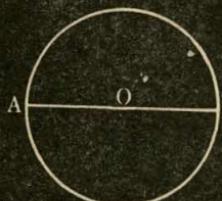


FIG. A

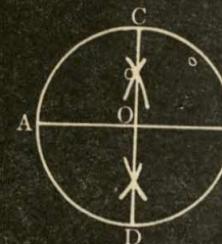


FIG. B

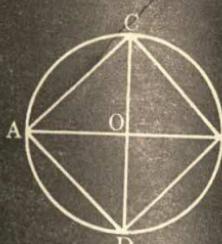


FIG. C

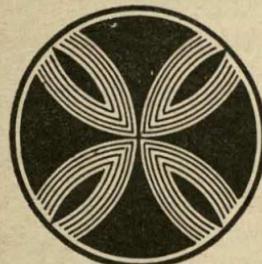


FIG. D

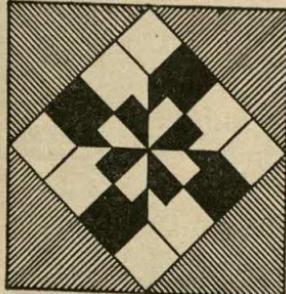


FIG. E



FIG. F

THE INSCRIBED SQUARE

1. Draw a circle with any given radius.
2. Draw any diameter to your circle, such as AOB .
3. Construct a second diameter, such as COD , perpendicular to the first.
4. Connect with straight lines the points AC ; CB ; BD ; DA .
5. What geometric figure have you constructed? This square is said to be **inscribed in the circle**. Why?
6. Construct Figure D, based on the circle.
7. Construct Figure E, based on the square.
8. Construct Figure F, based on the inscribed square.
- *9. Construct a regular inscribed octagon. (HINT: The sides of the inscribed square must be bisected.)

THE BEE KNOWS HIS GEOMETRY

1. Here is part of a honeycomb.

a. How many sides has each cell?

b. What name is given to a 6-sided plane figure?

c. If each side were the same length and each angle of equal size, what kind of hexagon would be formed?

2. Figure B is a regular inscribed hexagon. Measure with your compasses radius OA . How does OA compare in length with any side of the hexagon?

3. Tell how to inscribe a hexagon in a circle using compasses or ruler.

4. Construct a regular inscribed hexagon, $ABCDEF$, with sides 2 inches long.

5. Connect points B and C with the center of the circle. What kind of a triangle is formed?

6. How many diagonals can be drawn from each vertex of a hexagon?

7. In the figure which you constructed (problem 4), draw diagonal AD . What kind of geometric figure is each half of the hexagon?

8. An equilateral triangle may be formed by connecting alternate vertices of a hexagon. Construct an equilateral triangle by this method.

*9. Tell how to construct a figure of twelve equal sides. Construct such a figure.

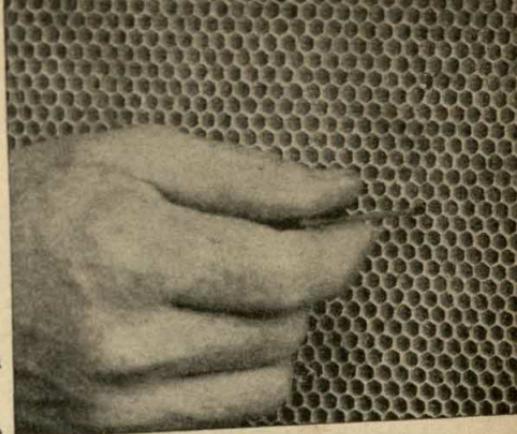


FIG. A

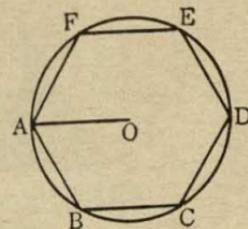
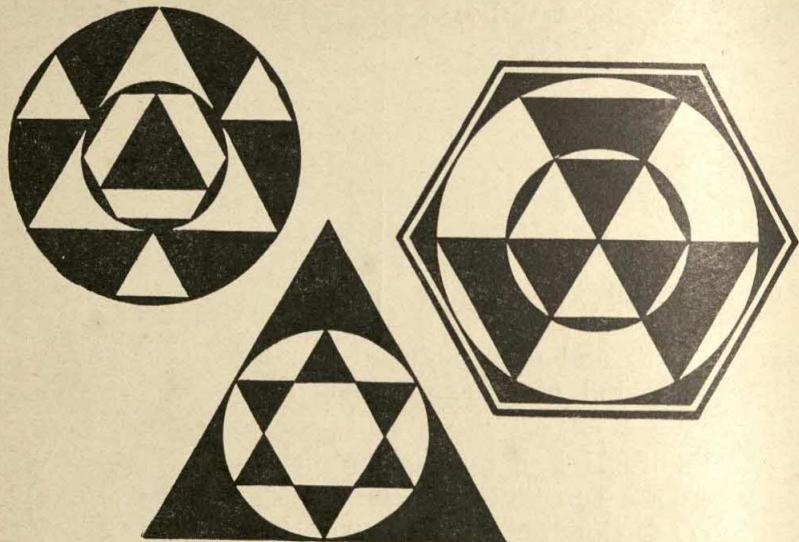
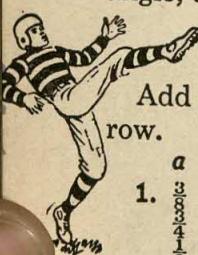


FIG. B



CIRCLE, TRIANGLE, AND HEXAGON

1. Construct two designs selected from those shown above. (Each design, as you see, requires for its construction some knowledge of circle, triangle, and hexagon.)
- *2. Construct an original design based on the circle, triangle, and hexagon.



LET'S PRACTICE

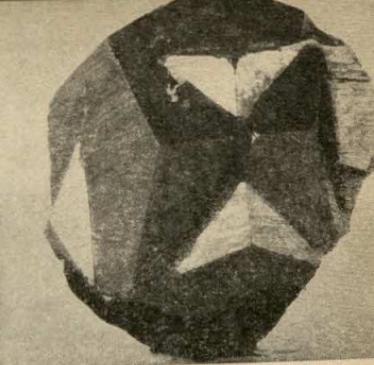
Add the examples in the first row; subtract in the second row.

11

a	b	c	d	e	f
1. $\frac{3}{4}$ $\frac{1}{2}$	$\frac{5}{6}$ $\frac{1}{2}$	$\frac{7}{6}$ $\frac{1}{4}$	$7\frac{3}{4}$ $6\frac{5}{8}$ $\underline{-} \quad \underline{\quad}$ $\frac{1}{2}$	$4\frac{7}{8}$ $9\frac{3}{5}$ $\underline{-} \quad \underline{\quad}$ $\frac{7}{4}$	$8\frac{7}{2}$ $6\frac{3}{4}$ $\underline{-} \quad \underline{\quad}$ $1\frac{1}{3}$
2. $\frac{5}{8}$ $\frac{1}{2}$	$\frac{11}{12}$ $\frac{3}{4}$	96 $\underline{58\frac{3}{8}}$	$42\frac{1}{2}$ $13\frac{3}{4}$ $\underline{-} \quad \underline{\quad}$	$24\frac{1}{3}$ $17\frac{5}{6}$ $\underline{-} \quad \underline{\quad}$	$82\frac{1}{4}$ $34\frac{5}{6}$ $\underline{-} \quad \underline{\quad}$

FIVE SIDES—FIVE POINTS— FIVE ANGLES

Pyrite is a kind of rock containing sulphur and iron. Almost perfect crystals of pyrite (Fig. A) are found.

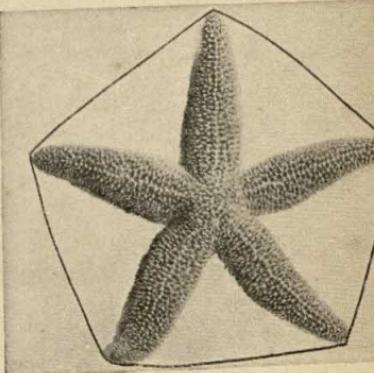


1. How many sides has each black face of this crystal?

2. What name is given to any 5-sided plane figure?

3. If each side of the face of the crystal were of equal length and the 5 angles of equal size, what kind of pentagon would be formed?

4. The starfish has a fishing line caught between each pair of its arms. What kind of figure does the line make?



5. What kind of figure would be formed between the line and each pair of arms?

6. Figure C is a regular inscribed pentagon. Copy it as follows:

a. Draw a circle with any radius.

b. At center, O, draw an angle of 72° ($360 \div 5 = 72^\circ$) and extend its sides to cut the circle.

c. Lay off 5 points on the circle the same distance apart as are the ends of the 2 radii.

d. Connect these points.

7. Draw a 5-pointed star; a 10-pointed star.

8. Draw this design.

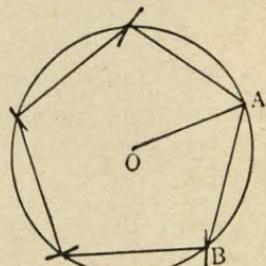


FIG. C

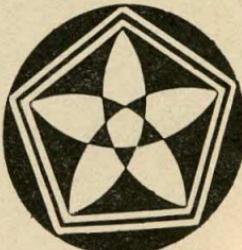
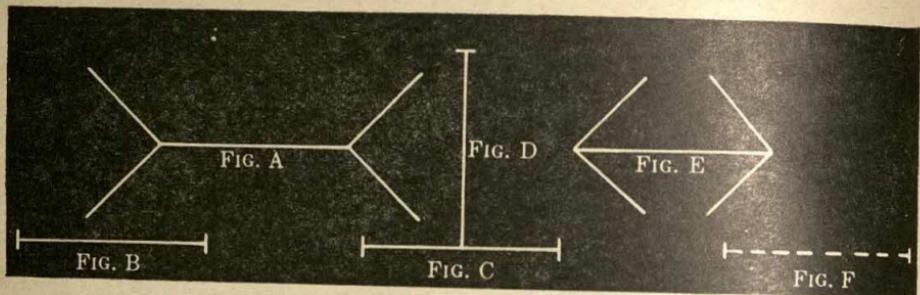


FIG. D



¹ BELIEVE IT OR NOT

1. "Believe it or not," all vertical and horizontal lines in Figures A, B, C, D, E, and F are of the same length. Prove by measurement.
2. "Believe it or not," the pairs of vertical lines (Figs. H, I) are parallel. Prove by use of any straight edge.
3. "Believe it or not," Figure G is constructed only of straight lines. Try to find a curved line in the figure.
- *4. "Believe it or not," a circle is sometimes called a regular polygon with an infinite number of sides. How does Figure G help you to understand this statement?

¹ Used by special permission of Robert "Believe-it-or-not" Ripley.

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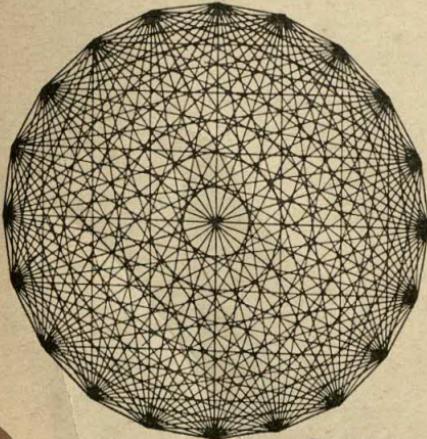


FIG. G

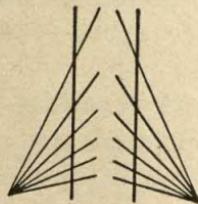


FIG. H

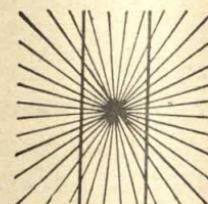
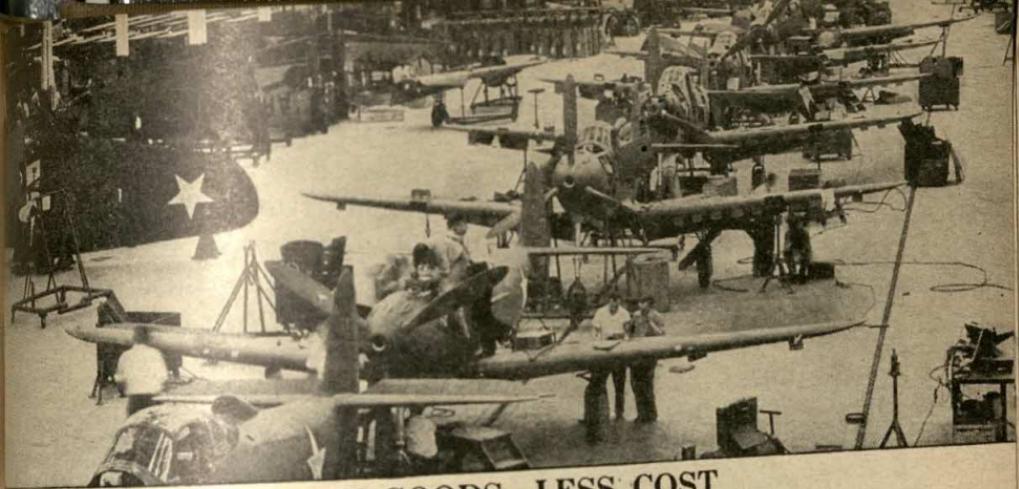


FIG. I



MORE GOODS—LESS COST

"Run down to the service station and get me a new hub cap for the car," said Mr. Scott to Frank, "and while you are about it, bring along a couple of spark plugs."

1. When the new hub cap was sprung on the wheel and the plugs screwed into place, they fitted as snugly as the parts which came with the car. Why?

2. Mr. Scott smashed a fender. Must he have a new fender built to his order or can he buy one ready-made? Why?

Articles exactly alike in size and form are said to coincide and to be **congruent**.

3. Name 5 objects which are **congruent** or **coincide** from each of the following groups of useful things.

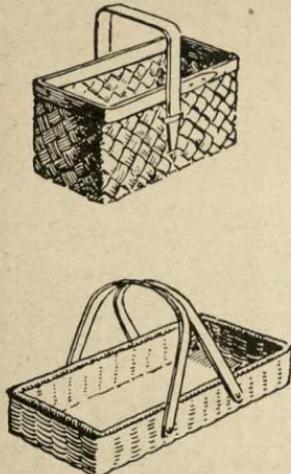
a. Furniture and house furnishings	c. Sporting goods
b. Clothing	d. Jewelry
	e. Automobile parts

4. How does the use of congruent parts keep down the cost of each part? increase the speed of production?

*5. How may the wider use of congruent parts increase the need for machines? decrease the need for workers?

*6. What is meant by standardization in industry?

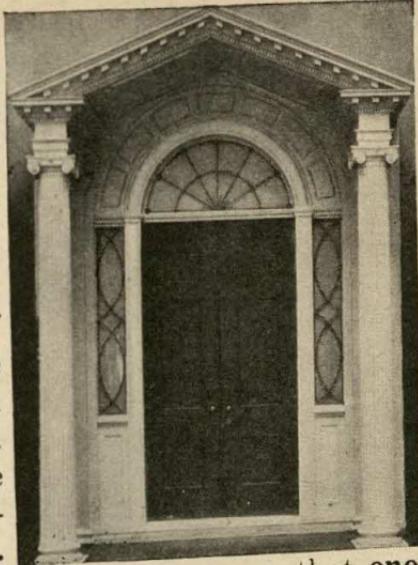
EQUIVALENT OR CONGRUENT



1. a. Here are two market baskets. Why are they not congruent?
b. Might they be equivalent, that is, of equal size? Why?
2. Under what condition would two bushel baskets be congruent? equivalent?
3. If two auto fenders are congruent, are they necessarily equivalent? Explain.
4. If two chocolate bars are equivalent in weight, are they necessarily congruent? Explain.
5. If the sides of each of two equilateral triangles are 3 inches, are the triangles equivalent? congruent? Why?
6. Two cans each hold exactly 1 gallon, the base of each is a square 5 inches on a side, and each side of the cans is a rectangle. Are the cans congruent? Explain.
- *7. If two isosceles triangles have equal bases and equal altitudes, are they equivalent? congruent? Explain.
- *8. If any two triangles have equal bases and equal altitudes, are they always equivalent? always congruent? Make drawings to prove your answer.
- *9. Can a right triangle be equivalent to an equilateral triangle? Use numbers to prove your answer.
- *10. Can two squares be equivalent and yet not be congruent? Explain.
- *11. Can a square be equivalent to a circle? Explain.
- *12. Can a square be equivalent to a triangle? congruent to a triangle? Explain.

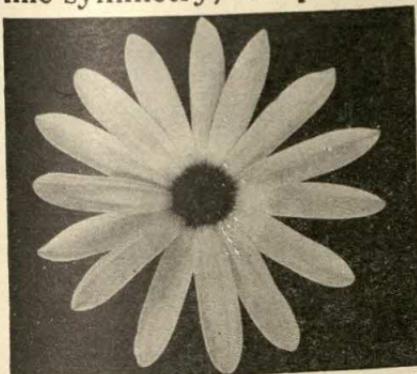
SYMMETRY, THE "MUSIC OF MATHEMATICS"

The picture shows the doorway of a New England house, built about 1800. If the vertical line between the two doors were extended to the roof of the porch, it would divide the doorway into two equal and congruent, but **opposite** parts. The dividing line is called the **axis of symmetry**. The doorway is said to be **symmetrical**.



The arrangement of two congruent figures, so that **one is opposite the other**, is found in plant and animal life, and is widely used in design.

There are three kinds of symmetry: **point symmetry**, **line symmetry**, and **plane symmetry**.



POINT SYMMETRY

In point symmetry, the line of symmetry begins at a point. Such flowers as the black-eyed Susan and the daisy are illustrations of point symmetry. In point symmetry, each diameter is an axis of symmetry.

1. How many lines of symmetry may be drawn in a circle?

2. If a circle is divided into two parts by a line which does not pass through the center, are the two parts symmetrical? Explain.



LINE AND PLANE SYMMETRY

Each maple leaf in Canada's Battle Flag represents line symmetry. The main rib divides the leaf into two congruent parts. This dividing line is

the axis of symmetry. In an isosceles triangle the altitude is the axis of symmetry.

1. Draw an isosceles triangle and construct its axis of symmetry. (Bisect the vertex angle.)

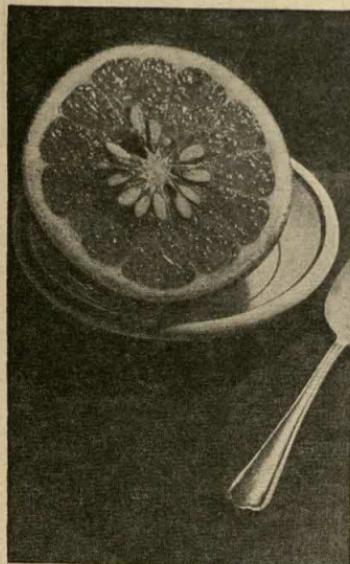
2. If a triangle has all sides unequal, can an axis of symmetry be constructed for the triangle? Check your answer by attempting to construct the axis of symmetry.

Cut an orange in half and put a sheet of waxed paper between the halves. The halves on each side of this plane are the same, so

the orange is symmetrical with respect to the plane. This is called plane symmetry.

3. Why is it possible to have more than one plane as an axis of symmetry for an orange or an apple?

4. For a plane to be an axis of symmetry of a sphere, must the plane pass through the center of the sphere? Explain.



SOME APPLICATIONS OF SYMMETRY

1. When one looks in a mirror, does his image represent symmetry or congruence?
2. What type of symmetry is represented by the wings of the butterfly?
3. What is the axis of symmetry in the antelope head?
4. In the living room, tell which furnishings are arranged symmetrically; which are not.
5. What is the line of symmetry in the kite?
6. How many lines of symmetry can you find in the snowflake? the butterfly?



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USING THE VOCABULARY OF ARITHMETIC

Define each term given below or use it correctly in a sentence. If you do not know the meaning of a term, turn to the key page in parentheses.

axis of symmetry	(215)	parallel lines	(206)
bisect	(205)	pentagon	(211)
coincide	(213)	perpendicular	(205)
congruent	(213)	plane symmetry	(216)
equivalent	(214)	point symmetry	(215)
inscribed polygon	(208)	regular polygon	(207)
line symmetry	(216)	segment of a line	(205)
octagon	(207)	symmetry	(215)

*TOPICS FOR SPECIAL REPORTS

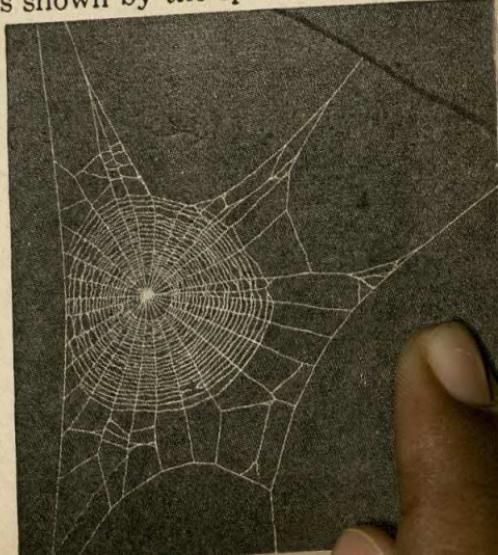
1. What is Gothic architecture? What kind of symmetry is represented by the Gothic arch?
2. Place a drop of ink on a sheet of paper and fold the paper. The ink blot forms what kind of symmetry?
3. List 6 different shapes used for highway signs. What signal does each shape flash to the motorist?
4. Letter the 26 capitals of the alphabet. Which are symmetrical?
5. Name some geometric figures used in buildings, linoleum, or in embroidery. Construct four of these patterns.
6. Three famous problems in mathematics which have not, as yet, been solved are: (1) squaring the circle; (2) trisecting an angle; and (3) doubling a cube. Find what is meant by each of these problems.
7. Draw two triangles. Bisect, at right angles, the sides of the one triangle. Bisect the angles of the other triangle. If your construction is correct, the bisectors in each triangle will meet in a point.



HOW WELL DO YOU REMEMBER?



1. What is a regular polygon?
2. What is the difference between drawing an angle and constructing an angle?
3. Draw an angle of 70° and bisect it. Check your construction by measuring each angle formed.
4. At point C on line AB , erect a perpendicular. On the perpendicular, measure segment $CD = 2$ inches. At point D draw a line parallel to AB . What kind of angle will the parallel line make with line CD ?
5. Construct an equilateral triangle.
6. If two triangles are congruent, do they have the same area? Why or why not?
7. If two triangles have the same area, must they be congruent? Why or why not?
8. If two triangles are congruent, are their perimeters equal? Why or why not?
9. If two figures are symmetrical, do they have the same area? Explain fully.
10. What is the difference between congruency and symmetry?
11. Name the three kinds of symmetry. Illustrate each.
12. What kind of symmetry is shown by the spider web?
13. Arrange two copies of this book so as to illustrate symmetry; to illustrate congruency.
14. How many degrees are at the center of a regular inscribed pentagon? a regular inscribed hexagon? a regular inscribed octagon?



THINGS TO REMEMBER

1. How to bisect a line and an angle.
2. How to construct an angle equal to another angle.
3. How to construct a perpendicular from a point to a line.
4. How to construct a line parallel to a given line.
5. The meaning of congruence and symmetry.

TEST ON CHAPTER IX

1. Draw a line $3\frac{1}{2}$ inches long and bisect it. Check the accuracy of your construction by measuring the two segments.

2. Draw angles of 80° and 150° and then bisect them. With your protractor test the accuracy of your construction.

3. Draw a triangle and construct an altitude from any vertex.

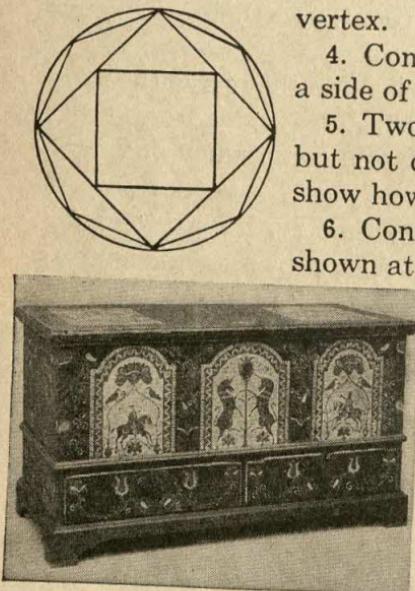
4. Construct a regular hexagon with a side of 2 inches.

5. Two fields are equivalent in area but not congruent. Make a drawing to show how this is possible.

6. Construct the geometric design shown at the left.

7. What type of symmetry is represented by:
a. sunflower;
b. elm leaf; c. double doorway; d. an orange?

8. The picture represents an 18th century Pennsylvania Dutch chest. Name parts of the design of the chest which are symmetrical; congruent.



PROGRESS TEST

Work the test and have your paper scored. If you made errors, turn to the key pages in parentheses where the work is explained.

1. (8)

368

976

409

354

765

2. (20)

17.6

9.3

0.8

3.5

20.7

3. (8)

40375

-20398

5. (12)

46) 30257

4. (9)

70304

×508

6. (22)

2.7) 18.657

7. What fraction multiplied by $\frac{6}{7}$ is equal to $\frac{3}{4}$? (18)

8. Multiply $16\frac{3}{4}$ by $8\frac{2}{3}$. (16)

9. The sum of two numbers is 148. If one of the numbers is 56.7, what is the other number? (20)

10. Write as per cents: $\frac{2}{3}$, $\frac{5}{8}$, .7, 1.3, 4. (61)

11. $12 = ? \%$ of 60 (66) 14. $\frac{1}{2}\%$ of 1500 = ? (72)

12. $60 = 15\%$ of ? (74) 15. $9 = 30\%$ of ? (74)

13. 175% of 450 = ? (65) 16. $350 = ? \%$ of 150 (66)

17. When the price of eggs increases from 25¢ to 35¢ a dozen, what is the per cent increase? (69)

18. When the price of wheat decreases from 90¢ to 75¢ a bushel, what is the per cent decrease? (69)

19. In the formula, $A = \frac{1}{2}bh$, find A when $b = 17$ and $h = 9$. (41)

20. In the formula $A = \frac{1}{2}bh$, find A when $b = 9\frac{3}{4}$ and $h = 15\frac{1}{2}$. (41)

21. A note for \$450 is discounted at 6% for 45 days. What are the proceeds? (117)

22. Find the value of a \$1000 bond quoted at $96\frac{3}{4}$. (141)



CHAPTER X

SOLIDS AND THEIR MEASURES

At Fairview School the boys in the upper grades have shop while the girls have cooking. Possibly you follow a like schedule in your school.

On parent-teachers' night each group exhibited samples (page 222) of its work.

1. Name objects made by the boys in the shop; by the girls in the school kitchen.

2. James showed his mother a book rack which he had made. "This rack, Mother, is 2 feet long, 26 inches deep, and 10 inches wide. The well for the books forms a right angle."

What other plane geometric figures do you recognize on the surfaces (**faces**) of the articles made by the pupils?

3. Think of any plane figure, such as the surface of this page.

a. How wide is it? b. How long?

c. How deep or thick?

d. Which question (a, b, or c) cannot be answered?

e. How many dimensions has a plane figure?

f. What are they?

4. a. How many dimensions has James' book rack?

b. What dimension does it have that the surface of this page, or any other plane figure, does not have?

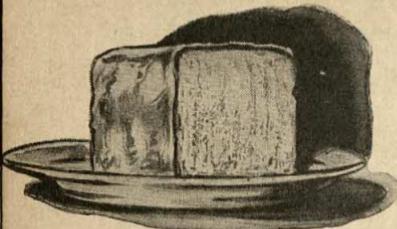
5. In arithmetic a **solid** is anything that has **length, width, and depth or thickness**.

a. Is an ice-cream cone a solid? Why or why not?

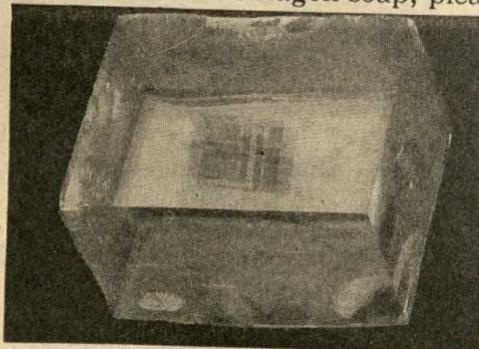
b. Is the ball of ice cream in the cone a solid? Why or why not?

c. May a solid be hollow? If so, name 5 such solids.

PRISMS



1. Mary's sponge cake, which she exhibited (page 222), is shown again in larger scale on this page.
 - a. Is this sponge cake a solid? Why or why not?
 - b. What is the shape of each surface (**face**) of the cake?
 - c. Is the bottom of the cake parallel to the top? Are the opposite sides parallel?
 - d. Why might this sponge cake be called a **rectangular solid**? In arithmetic we would call it a **rectangular prism**, because it is a **solid**, and its opposite sides are **rectangles** and are **parallel**.
2. How many sides or faces does a rectangular prism have?
3. How many pairs of equal sides does a rectangular prism have?
4. A six-sided pencil, before it is sharpened, is what kind of prism?
5. What kind of prism is this crystal of Iceland spar? (Iceland spar is one form of the mineral, calcite. Other forms are chalk and marble.)
6. "A bar of Octagon soap, please," ordered a customer.



What kind of prism is a cake of this soap?

7. John noticed that his young brother's building blocks had 6 equal **square** faces or sides. What name is given to this form of rectangular prism (page 226)?

THE CAPACITY OF AN EGG CRATE

1. In the carton:
 - a. How many eggs have been placed in each row?
 - b. How many rows?
 - c. How many eggs in the top layer?
 - d. In the bottom layer?
 - e. How many eggs in the carton?
 - f. How many dozen is that?

2. a. An egg carton has 8 eggs to a row and 6 rows to a layer. How many eggs are there to each layer?

b. If the carton has 4 layers, how many eggs will it contain?

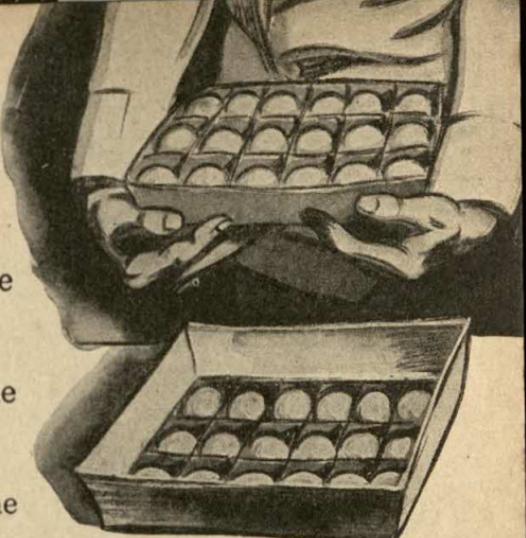
c. How many dozen is that?

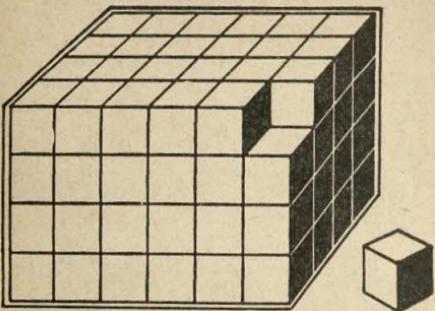
The number of eggs which a carton will contain is its capacity; that is, the number of units of measure it will hold. The unit of measure of the carton above is one egg. The number of these units which the carton will hold is the product of the number of eggs in one layer and the number of layers.

*3. An egg carton has e eggs to a row and r rows. Write the formula for the number of eggs to a layer. Let N = the number.

*4. If there are L layers to the carton (problem 3), write the formula for the number of eggs the carton will contain. Let N = the number.

*5. Write the formula for the number of dozens the carton (problems 3, 4) will hold. Let D = the number of dozens.





VOLUME OF A RECTANGULAR PRISM

1. Here is a box of building blocks, one of which has dropped from the box. Each face of this block is one inch square. What kind of a rectangular prism is it?
2. a. If the cube is one inch on a side, how many cubic inches does it contain? (HINT: $1'' \times 1'' \times 1'' = ?$ cu. in.)
b. Volume is the number of cubic units which a solid contains. What is the volume of the building block?
3. How many cubes are in one layer of building blocks?
4. How many cubes are in the entire box?
5. How many cubic inches does the box contain?

There are 6 cu. in. in one row of the top layer.

There are 4 rows in the top layer.

Then there are 4×6 cu. in., or 24 cu. in., in one layer.

There are 4 layers.

Then there are 4×24 cu. in., or 96 cu. in., in the box.

$96 = 4 \times 6 \times 4$, the product of the three dimensions: length, width, height.

RULE: The volume (number of cubic units) of a rectangular solid is equal to the product of the number of linear units in its length, width, and height.

FORMULA:

$$V = lwh$$

6. a. What does each letter in the formula represent?
 b. Tell what the formula means.
 c. Assume that $l = 2$, $w = 3$, and $h = 4$, and prove that the value of V does not change if the formula is written $V = whl$, $V = hwl$, or $V = lhw$.
 7. In a box there are 8 cubes in each row with 6 rows in a layer. How many cubes will the box hold if there are 4 layers?
 8. Find the volume of the following rectangular prisms:

<i>a.</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>*g</i>
$l = 6$ in.	8 ft.	12 in.	5 yd.	4.6 ft.	25 in.	30 cm.
$w = 4$ in.	6 ft.	12 in.	2 yd.	3.1 ft.	18 in.	16 cm.
$h = 4$ in.	4 ft.	12 in.	3 yd.	2 ft.	9 in.	15 cm.
$V = ?$?	?	?	?	?	?

9. A cord of wood is a pile 8 feet long, 4 feet wide, and 4 feet high. How many cubic feet of wood are in a cord?

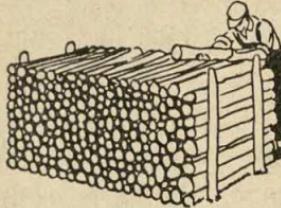
10. At 40¢ a cubic foot, find the cost of building a cement wall 8 inches thick, 4 feet high, and 150 feet long.

11. A cubic foot of ice weighs about $57\frac{1}{2}$ pounds. At 50¢ a 100 pounds, find the cost of a piece of ice 18 inches long, 12 inches wide, and 15 inches high.

*12. A quarter pound of butter is $4\frac{1}{2}$ inches long and $1\frac{1}{4}$ inches square. How many cubic inches are there to a pound of this butter?

*13. A cubic foot of a certain quality of granite weighs 175 pounds. Find the weight of a rectangular piece of this granite, 6 feet long, $2\frac{1}{2}$ feet wide, and 4 inches thick.

*14. Measure the inside dimensions of any rectangular box. How many cubic inches does your box contain?



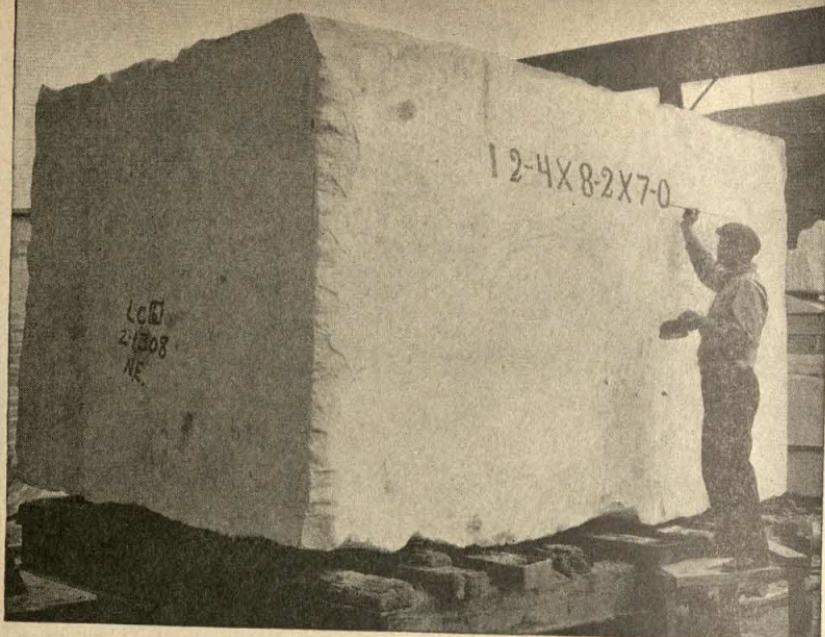


FIG. A. This huge block of marble was quarried near Proctor, Vermont.

A 64-TON BLOCK OF MARBLE

One of the largest blocks of marble ever quarried is shown in Figure A. This block is one of two such blocks required for support at the main entrance of the United States Supreme Court Building, Washington, D. C.

1. What are the dimensions as painted on this block of marble (12-4 means 12 feet, 4 inches)?
2. What is its volume? (Assume that the block is a rectangular prism.)
- *3. The block, as you see it, weighed about 64 tons. How much did it weigh a cubic foot? Select from the following weights the one closest to the true weight:
a. 150 lb.; b. 175 lb.; c. 180 lb.; d. 190 lb.; e. 200 lb.

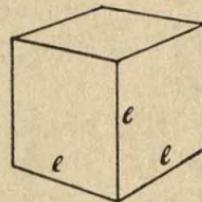
THE VOLUME OF A CUBE

A cube, as you may recall, is a rectangular prism all sides of which are equal. Therefore, $l = w = h$. The formula for a rectangular prism, $V = lwh$, when used for a cube can be written, $V = l \times l \times l$; or $V = w \times w \times w$; or $V = h \times h \times h$.

In writing the formula for the volume of a cube, e is generally used for edge. The formula then becomes

$$V = e \times e \times e = e^3.$$

e^3 is read "e-cube." It means that e is used three times as a factor. If $e = 4$, then $e^3 = 4 \times 4 \times 4$, or 64.



1. Find the number of cubic inches in a cube, 12 inches on a side.
2. How many cubic feet of ice are in a cube, 2 feet on a side?
3. If a cubic foot of ice weighs $57\frac{1}{2}$ pounds, find the weight of a cubic block of ice, 2 feet on a side.
4. How many one-inch cubes are required to make a cube 2 inches on a side? 3 inches on a side? 4 inches on a side?
5. Write the cubes of all of the numbers from 1 to 12.
6. If you forget the number of cubic inches in a cubic foot, how can you compute the number?
7. Prove that there are 27 cubic feet in a cubic yard.
- *8. Doubling the edge of a cube has what effect on its volume?
- *9. Prove that the area of a cube is $6e^2$.
- *10. Doubling the edge of a cube has what effect on its area?

FINDING THE VOLUME OF ANY PRISM

1. a. Mary is eating a brick of ice cream 2" long, 1" high, 4" wide. After she has finished, what volume of ice cream will she have eaten?
b. What formula did you use to find this volume?
c. What was the area of the base of this brick of ice cream? (HINT: $l \times w$.)
d. Rewrite the formula (volume of a rectangular prism) and substitute B (base) for lw .
e. Find the volume of the brick of ice cream, using the formula $V = Bh$.
f. What does B represent in this formula?

RULE: The volume of a prism is equal to the product of the number of square units in its base and the number of linear units in its height.

$$\text{FORMULA: } V = Bh$$

2. Find the following:

B	a	b	c	d	e
$= 18$ sq. in.	27 sq. ft.	15.6 sq. ft.	56 sq. cm.	$12\frac{1}{4}$ sq. ft.	
h	5 in.	4 ft.	3.4 ft.	12 cm.	$2\frac{1}{2}$ ft.
V	?	?	?	?	?

LET'S PRACTICE

a	b	c
1. $9\frac{1}{2} \times 37 = ?$	$16\frac{3}{8} - 11\frac{3}{4} = ?$	$370 \times 580 = ?$
2. $165 \overline{) 72397}$	$4\frac{1}{2} \div 2\frac{3}{8} = ?$	$1.8 \times 6.55 = ?$
3. $.25 \times .45 = ?$	$1.1 \overline{) 176}$	$16 \overline{) 9}$
4. $1.5\% \text{ of } 45 = ?$	$\frac{1}{2}\% \text{ of } 780 = ?$	$345\% \text{ of } 26 = ?$
5. $15 = ?\% \text{ of } 120$	$300 = ?\% \text{ of } 120$	$30 = ?\% \text{ of } 36$
6. $18 = 6\% \text{ of } ?$	$40 = 125\% \text{ of } ?$	$57 = 1\% \text{ of } ?$
7. $102.5\% \text{ of } 150 = ?$	$60 = 120\% \text{ of } ?$	$800 = ?\% \text{ of } 300$

12

RECTANGULAR SOLIDS

1. Jack is building a bin, 8 feet long and 5 feet wide, inside dimensions, to hold 160 bushels of shelled corn when level full. Allowing $1\frac{1}{4}$ cubic feet to a bushel, how high should he build the bin?

Since 1 bu. occupies $1\frac{1}{4}$ cu. ft. of space, 160 bu. will occupy $160 \times 1\frac{1}{4}$ cu. ft., or 200 cu. ft.

The area of the base is 40 sq. ft. ($8 \times 5 = 40$)

Then, $200 \div 40 = 5$, no. of ft. in height of the bin.

2. Allowing 42 cubic feet to a ton of soft coal, to what depth will 10 tons of coal fill a bin with a floor area of 70 square feet?

3. A triangular prism has a volume of 96 cubic feet. If the prism is 2 feet high, what is the area of its base?

4. A farmer has 440 bushels of wheat stored in a bin, 12 feet long and 5 feet wide. To what depth is the bin filled? ($1\frac{1}{4}$ cu. ft. = 1 bu.)

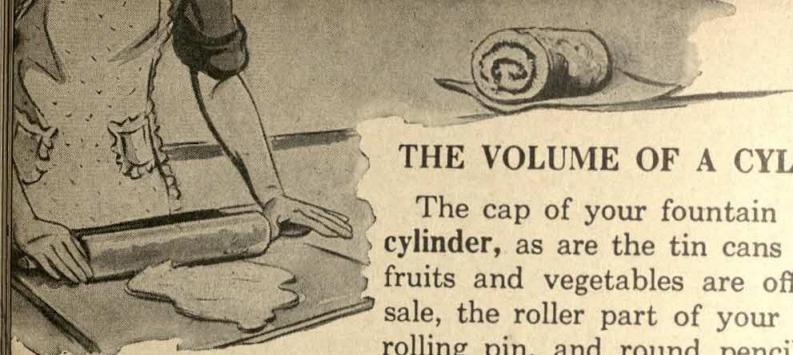
5. An aquarium, 24 inches long and 14 inches wide, contains 12 gallons of water. If a gallon contains 231 cubic inches, what is the depth of the water?

6. The bed of an autotruck is 9 feet long, 5 feet wide, and $1\frac{1}{2}$ feet high (inside dimensions). If a cubic yard contains 27 cubic feet, how many cubic yards of dirt will the truck hold when level full?

*7. If a cubic foot contains .8 of a bushel, to what depth will 240 bushels of grain fill a rectangular bin, 12 feet long and 5 feet wide?

*8. If the three dimensions of a rectangular prism are doubled, how has the volume been changed?

*9. If two dimensions of a rectangular prism are doubled, how has the volume been changed?



THE VOLUME OF A CYLINDER

The cap of your fountain pen is a **cylinder**, as are the tin cans in which fruits and vegetables are offered for sale, the roller part of your mother's rolling pin, and round pencils before sharpening. A cylinder, therefore, is a solid—round, and with 2 circular ends (bases), equal and parallel.

1. How long is the cap of your fountain pen or your circular pencil? What is the diameter of its base? Why may either object be called a **circular prism**?
2. The formula for the volume of a prism is $V = Bh$. The base of a cylinder is a circle. Therefore the formula for the volume of a cylinder is $V = \pi r^2 h$. Why?
3. Helen found that the diameter of the inside of a cylindrical can was 4 inches; its height, 5 inches. How many cubic inches did the can contain?

$$\text{If } d = 4, r = 2$$

$$\pi = \frac{22}{7}$$

$$h = 5$$

$$V = ?$$

$$V = \pi r^2 h, \text{ the formula}$$

$$V = \frac{22}{7} \times 2 \times 2 \times 5$$

$$V = 62\frac{6}{7}$$

The volume is $62\frac{6}{7}$ cubic inches.

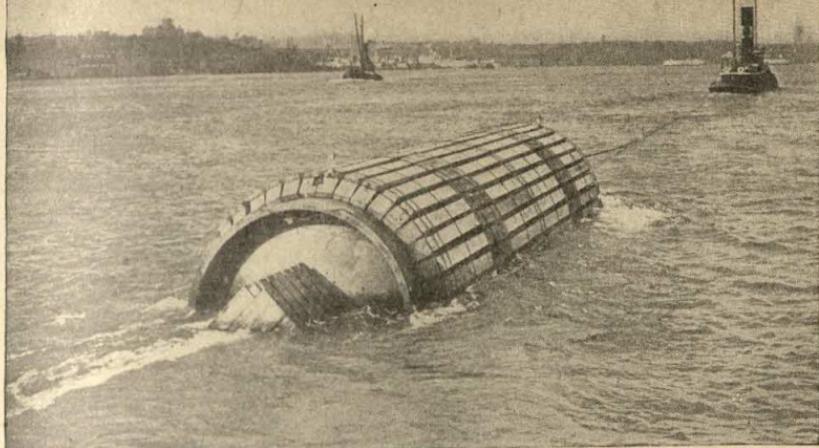
Find the volume of cylinders whose dimensions are:
(Use $\pi = \frac{22}{7}$)

$$4. r = 3 \text{ in., } h = 7 \text{ in.} \quad 7. r = 5 \text{ ft., } h = 12 \text{ ft.}$$

$$5. r = 4 \text{ ft., } h = 6 \text{ ft.} \quad 8. r = 1 \text{ yd., } h = 4 \text{ yd.}$$

$$6. r = 3\frac{1}{2} \text{ ft., } h = 6 \text{ ft.} \quad 9. r = 20 \text{ cm., } h = 35 \text{ cm.}$$

*10. A hot-water tank is 18 inches in diameter and 42 inches high. How many gallons will it hold? (231 cu. in. = 1 gal.; 1 cu. ft. = $7\frac{1}{2}$ gal.)



FLOATING A CYLINDER

This cylindrical tank was towed from New York City up the Hudson River, through the Erie Canal, Lakes Erie, Huron, and Michigan to Whiting in northern Indiana, a distance of about 1370 miles.

1. The tank weighs about 460,000 pounds. How many tons is that?
2. It is 80 feet long and 15 feet in diameter, inside dimensions. What is its volume?
3. The tank is used for the storage of oil. Allowing $7\frac{1}{2}$ gallons to a cubic foot, find the number of gallons of oil which may be stored in this tank.
4. The tank is 25 feet longer than a standard flat freight car. What is the length of a standard freight car?
5. The time required to tow the tank was 16 days. What was the average distance moved each day?
- *6. The **specific gravity** of an object is found by dividing its weight by the weight of a like volume of water. If a cubic foot of steel weighs 460 pounds and a cubic foot of water weighs 62.5 pounds, find the specific gravity of steel.
- *7. Steel is much heavier than water. Why did this huge steel tank float, not sink?



PYRAMIDS AND CONES

FIG. A

In first place among "*The Seven Wonders of the World*," as chosen by the peoples of ancient Greece, were the Pyramids of Egypt (Fig. A). These great tombs of the kings have given their name, pyramid, to all solids having triangular sides which meet in a point at the top.

1. What is the shape of each side (face) of the Pyramid of Cheops (Fig. A)? Its highest point is the vertex of the pyramid.

2. What is the shape of its base?

3. Cheops, as originally built, was 768 feet square. Why might it be called a square pyramid?

4. What would you call a pyramid having: *a*. a triangular base? *b*. a rectangular base? *c*. a hexagonal base? *d*. an octagonal base?

5. Cheops originally was 482 feet high. This altitude is the perpendicular distance between its base and vertex. (Fig. B.) How much higher or lower is this than the world's tallest building (1248 ft.)?

6. Sharpen a pencil in a pencil sharpener. The writing end of the pencil is now in the form of a cone. What is the chief difference between a pyramid and a cone?

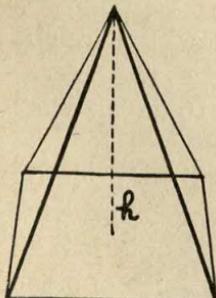
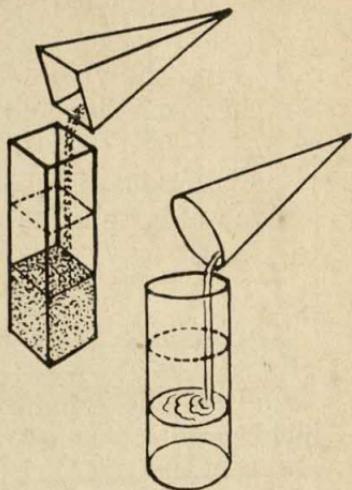


FIG. B

Construct from cardboard or stiff paper a hollow prism and a hollow pyramid having the same height and base. Fill the pyramid with sand or water and pour it into the prism. When you have finished, the prism will be $\frac{1}{3}$ full.

In like manner, construct a cone having the same base and the same height as a cylindrical jar. Pour sand or water into the cone. Then empty it into the cylinder. When you have finished, the jar will be $\frac{1}{3}$ full.



7. The volume of a pyramid is what part of the volume of a prism of the same base and altitude?

8. Write the formula for the volume of a prism.

9. The formula for the volume of a pyramid must be

$$V = \frac{1}{3}Bh \text{ or } \frac{Bh}{3}$$

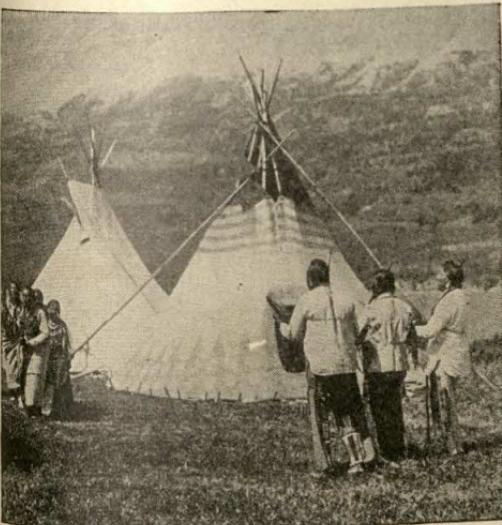
Why?

10. The volume of a cone is what part of the volume of a cylinder of the same base and height?

11. The formula for the volume of a cone must therefore be

$$V = \frac{1}{3} \pi r^2 h \text{ or } \frac{\pi r^2 h}{3}$$

Why?



VOLUMES OF PYRAMIDS AND CONES

1. Find the volume of a pyramid having a square base 6 inches on a side and an altitude of 8 inches.

$$\text{Side of square base} = 6$$

$$\text{Area of base} = 36$$

$$h = 8$$

$$V = ?$$

$$V = \frac{Bh}{3}, \text{ the formula}$$

$$V = \frac{1}{3} \times 36 \times 8$$

$$V = 96$$

The volume of the pyramid is 96 cubic inches.

2. Find the volume of a cone which has an altitude of 6 inches and a base with a radius of $3\frac{1}{2}$ inches.

$$r = 3\frac{1}{2} \text{ or } \frac{7}{2}$$

$$\pi = \frac{22}{7}$$

$$h = 6$$

$$V = ?$$

$$V = \frac{1}{3}\pi r^2 h, \text{ the formula}$$

$$V = \frac{1}{3} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 6$$

$$V = \frac{\frac{1}{3} \times \frac{22}{7} \times \frac{11}{2} \times \frac{1}{7} \times \frac{1}{2} \times 6}{\frac{1}{1} \times \frac{1}{7} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{1}} = 77$$

The volume of the cone is 77 cubic inches.

Find the volumes of pyramids whose dimensions are:

AREA OF BASE HEIGHT

3. 36 sq. in. 8 in.

4. 24 sq. ft. 14 ft.

5. 42.6 sq. ft. 7.3 ft.

AREA OF BASE HEIGHT

6. 15 sq. yd. 4 yd.

7. 54 sq. in. 7 in.

8. 20.6 sq. ft. 3.5 ft.

Find the volumes of cones whose dimensions are:
(Use $\pi = 3.14$)

RADIUS HEIGHT

9. 3 ft. 7 ft.

10. 6 in. 9.5 in.

RADIUS HEIGHT

11. 6 ft. 12 ft.

12. 10 in. 14.5 in.

RADIUS HEIGHT

13. 8 in. 12.8 in.

14. 15 in. 36.5 in.

15. Find the volume of a pyramid, 15 feet high, which has a rectangular base, 8 feet long and 4 feet wide.

16. A granite monument in the shape of a pyramid is 10 feet high and has a square base 6 feet on a side. If a cubic foot of this granite weighs 180 pounds, find the weight of the monument.

17. Find the volume of a cone having a radius of 8 inches and a height of 14 inches. (Use $\pi = \frac{22}{7}$)

18. A conical pile of sand has a diameter of 14 feet and a height of $5\frac{1}{2}$ feet. About how many loads of $2\frac{1}{2}$ cubic yards each are in the pile? (Use $\pi = \frac{22}{7}$)

19. A conical pile of wheat has a diameter of 10 feet and a height of $3\frac{1}{2}$ feet. If a cubic foot contains .8 of a bushel, how many bushels are in the pile? (Use $\pi = \frac{22}{7}$)

*20. If the height of a pyramid or a cone is doubled, what effect does this have on the volume?

*21. If the area of the base of a pyramid or a cone is doubled, what effect does this have on the volume?

*MAGIC SQUARE

Here is shown a magic square with some of its cells vacant. Draw a square containing 36 cells and copy the numbers given. Then find the missing numbers.

?	$\frac{1}{12}$	$\frac{1}{2}$	$2\frac{1}{6}$?	?
$\frac{1}{4}$	?	$\frac{7}{12}$	$1\frac{3}{4}$	?	$2\frac{1}{12}$
$2\frac{7}{12}$	$\frac{3}{4}$	?	$1\frac{5}{6}$	$2\frac{1}{4}$	$1\frac{2}{3}$
$\frac{2}{3}$	$2\frac{1}{3}$	?	$1\frac{5}{12}$	$\frac{5}{6}$	$1\frac{1}{4}$
$2\frac{1}{2}$	?	$2\frac{5}{6}$	1	$1\frac{1}{6}$	$1\frac{1}{3}$
$\frac{1}{3}$	3	$2\frac{5}{12}$	$1\frac{1}{12}$	$1\frac{1}{2}$?



WHAT TIME IS IT?

Short, the dog shown before the microphone, barked. His voice was radioed around the world and back to the studio in $\frac{1}{8}$ of a second. Short mistook his bark for another's and kept up the conversation until cut off the air.

By radio, and in other ways, we have proved that our earth is almost a perfect sphere—

curved like a ball so that all points on its surface are equally distant (or nearly so) from a point within called the **center**.

1. What is the distance around the world at the equator?
2. If radio waves travel about 186,000 miles a second, prove that they can encircle the earth in about $\frac{1}{8}$ of a second.
3. If the earth is a sphere, how many degrees are there around it in any direction?
4. What do you call distances east or west around the earth, measured in degrees?
5. What lines are drawn on globes and maps to mark degrees of longitude?
6. The **prime or first meridian**, as you recall, passes through both poles of the earth and through Greenwich (London), England. What do you call distances in degrees east of the prime meridian? west of it?
7. Prove that the greatest longitude a place can have is 180° east or west.

8. a. How many hours does the earth require to make one complete turn or **rotation**?

b. Through how many degrees does it turn in one day?

c. Through how many degrees does it turn in one hour?

d. How long does the earth require to turn one degree in longitude? fifteen degrees?

9. What would be the difference in time of two places separated by 30° of longitude? 45° ?

10. If London is on the 0° meridian and New York is near the 75° meridian, what is the difference in time between the two cities?

11. If the time is 12 noon in London, what is the standard time on the 180° meridian?

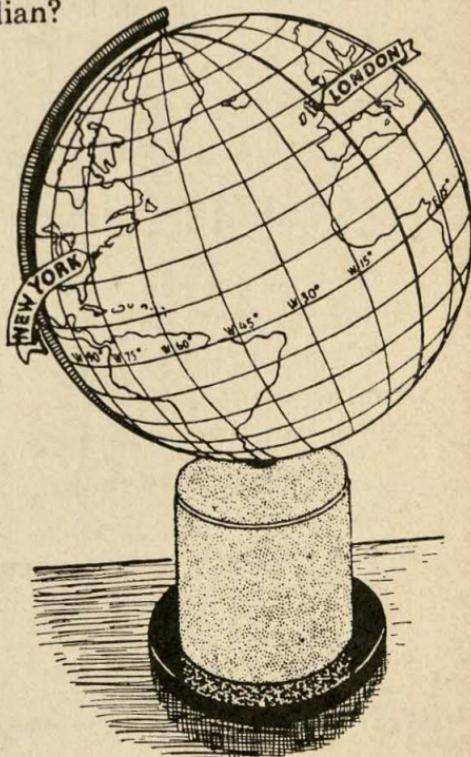
*12. On or near this meridian (180°) is the international date line where the date changes and the day is said to begin.

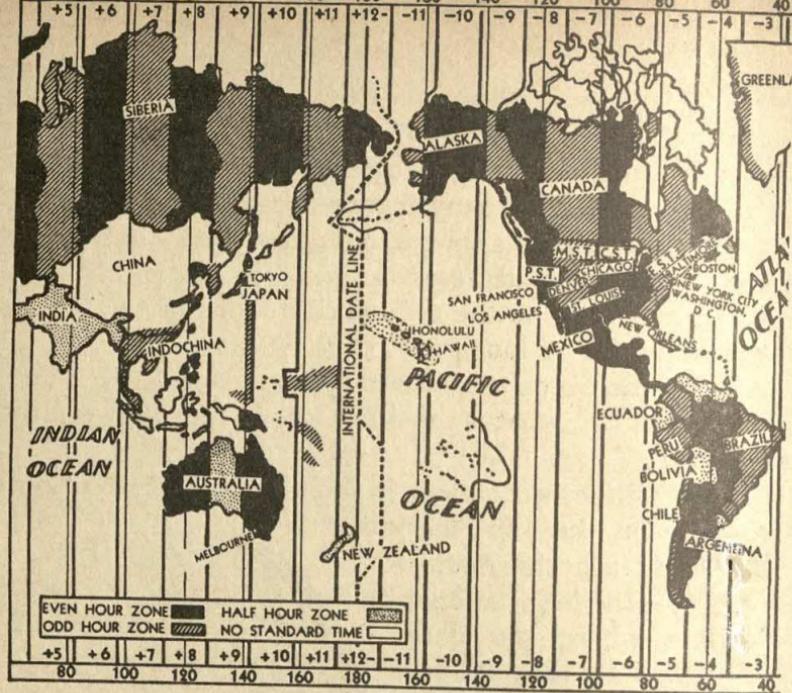
a. If the day is Saturday just east of this line, what day is it just west of the line?

b. If the day is Tuesday just west of the line, what day is it just east of the line?

c. If you crossed the international date line in a plane flying eastward, would you reset your watch? Explain.

*13. How many calendar days are there on the earth all the time?

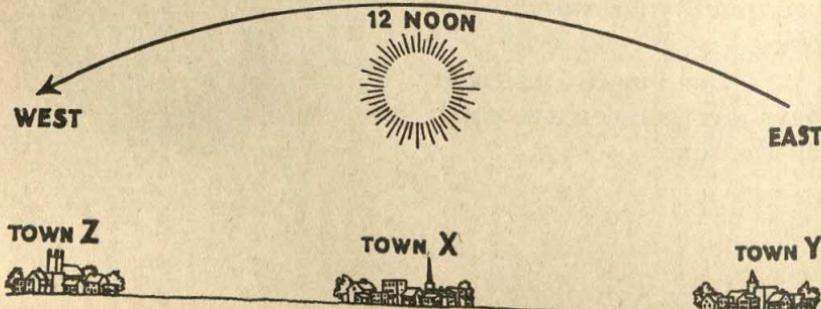


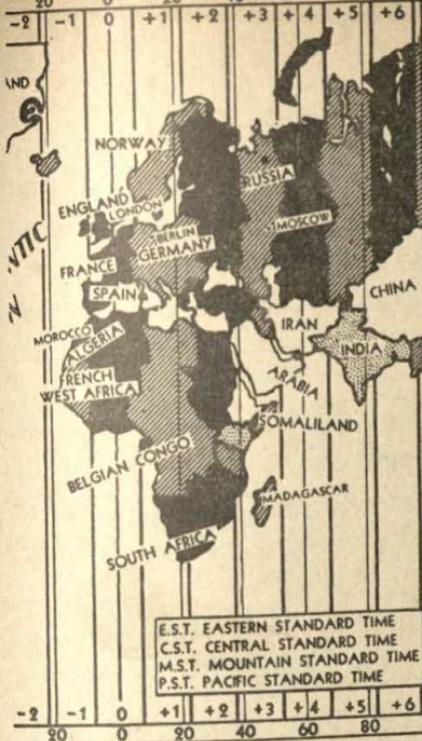


TIME DIFFERENCES BETWEEN PLACES

1. When the sun crosses the meridian of any place, the sun time of that place is **12 noon, or 12M (meridian)**.
 - a. Does the sun appear to move from east to west or from west to east?
 - b. What is meant by A.M.? P.M.?
 - c. When it is 12 noon (sun time) at town X, is it A.M. or P.M. (sun time) in town Y, one mile east? in town Z, one mile west?

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d. If all places on the earth followed sun time, what difficulties would occur? (HINT: Train and bus schedules, getting to work, shopping.)

2. Most of the nations of the world have agreed on a division of the surface of the earth into **time zones**.

a. Into how many time zones has the earth been divided?

b. About what is the width in degrees of each zone? (See top or bottom of the maps.)

3. Find the difference in time between any two adjacent zones. (All places within any one zone have the same time.)

4. In the United States the time zones are "Eastern standard time," "Central standard time," "Mountain standard time," and "Pacific standard time." In which zone do you live?

5. When it is 12 noon on the 75° meridian, what time is it all through the "Eastern" belt? "Central" belt? "Mountain" belt? "Pacific" belt?

6. When it is 12 noon on the 90° meridian, what time is it all through the "Central" belt? "Eastern" belt? "Pacific" belt? "Mountain" belt?

7. In what time belt is: a. Chicago? b. New York City?
c. San Francisco? d. Denver? e. Washington, D. C.?
f. New Orleans?

TIME DIFFERENCES—Continued

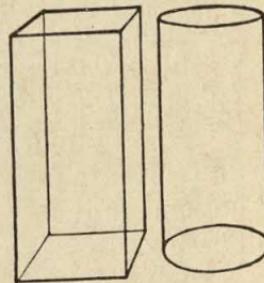
8. Why are the boundaries of the time belts in the United States so irregular? (HINT: Suppose the 90° meridian ran down the main street of your community.)
9. When it is 4 P.M. on the Pacific coast of the United States, what time is it on the Atlantic coast of our country?
10. A difference of 1 hour of time between two places is equal to how many degrees of longitude?
11. When it is 9 A.M. Eastern standard time in New York City, what is the standard time in Los Angeles? in Denver? in Chicago?
12. When it is 9 A.M. Pacific standard time in Los Angeles, what is the standard time in Denver? in Chicago? in New York City?
13. When it is noon in St. Louis, what is the standard time in Washington, D. C.?
14. If you should travel from Boston to Denver, how would you reset your watch to have standard time in Denver?
15. If you should travel from Denver to Baltimore, how would you reset your watch to have standard time in Baltimore?
- *16. State under what conditions in traveling you would set your watch ahead and how much; when you would set your watch back and how much.
- *17. When it is 12 noon on Monday at Washington, D. C., tell what time and day it is at

London, England
Berlin, Germany
Moscow, Russia

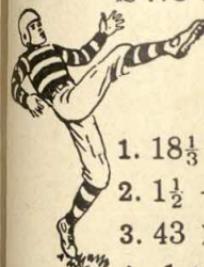
Tokyo, Japan
Melbourne, Australia
Honolulu, Hawaii

*TOPICS FOR SPECIAL REPORTS

1. Make a formula for finding the area of the sides of a rectangular prism; the surface area of a cylinder.
2. What is meant by soilless gardening? How is a knowledge of cubical content necessary for the preparation of a soilless garden?
3. Name at least six illustrations in your home or community of each solid which you studied in this chapter.
4. Make a table showing the formula for the area of every plane figure and the formula for the volume of every solid figure which you have studied in this book.
5. a. A **geographic mile** equals one minute of longitude at the equator. Find the circumference of the earth at the equator in geographic miles.
b. As a geographic mile equals about 1.152 statute miles, find the circumference of the earth in statute miles.
6. This prism has a square base equal to the diameter of the cylinder. The heights of the two objects are the same. Prove that the volume of the cylinder is .78 the volume of the prism.



LET'S PRACTICE



13

<i>a</i>	<i>b</i>	<i>c</i>
1. $18\frac{1}{3} - 11\frac{5}{6} = ?$	$9\frac{1}{4} \times 42 = ?$	$27 \div \frac{3}{4} = ?$
2. $1\frac{1}{2} \div 4 = ?$	$3\frac{2}{3} \times 4\frac{1}{2} = ?$	$175 \overline{)74460}$
3. $43 \times 28.5 = ?$	$75 \div .8 = ?$	$.45 \times 3.8 = ?$
4. $.1 \times .1 = ?$	$6.5\% \text{ of } 140 = ?$	$38 = ? \% \text{ of } 19$
5. $\frac{1}{2}\% \text{ of } 4800 = ?$	$15 = 3\% \text{ of } ?$	$101.5\% \text{ of } 12 = ?$
6. $720 = 150\% \text{ of } ?$	$3 = ? \% \text{ of } 300$	$15\% \text{ more than } 20 = ?$



HOW WELL DO YOU REMEMBER?



1. If a rectangular prism has all of its faces equal, what kind of a figure is it?
2. What is the formula for the volume of a rectangular prism? State the rule which the formula represents.
3. Find the volume of a rectangular prism whose dimensions are as follows: *a.* $l = 9$ in., $w = 5$ in., $h = 8$ in.; *b.* $l = 14$ ft., $w = 9\frac{1}{2}$ ft., $h = 5\frac{1}{2}$ ft.; *c.* $B = 56$ sq. ft., $h = 7$ ft.; *d.* $B = 78$ sq. in., $h = 9\frac{1}{4}$ in.
4. A cubic foot of water contains about $7\frac{1}{2}$ gallons. If a rectangular trough is 12 feet long, 1 foot wide, and 8 inches deep, how many gallons will it hold when full?
5. A bin, $12' \times 5' \times 8'$, is filled level with wheat. If a cubic foot of wheat contains .8 of a bushel, find the number of bushels in the bin.
6. A rectangular solid, 6 feet high, has a volume of 300 cubic feet. What is the area of its base?
7. A cylindrical tank for storage of fuel oil is 7 feet long and 3 feet in diameter. If a cubic foot of fuel oil contains $7\frac{1}{2}$ gallons, find the number of gallons the tank contains when filled. (Use $\pi = \frac{22}{7}$)
8. Using the formula $V = \frac{1}{3}Bh$, find V when $B = 36$ and $h = 8$.
9. Using the formula $V = \frac{1}{3}\pi r^2 h$, find V when $r = 3\frac{1}{2}$, $h = 6$. (Use $\pi = \frac{22}{7}$)
10. What is the difference in the time of two places if their difference in longitude is 60° ? 75° ? 105° ?
11. Name the time belts in the United States and give the standard time in each belt when the time on the Atlantic seaboard is 1 P.M.
12. Are all rectangular prisms cubes? Are all cubes rectangular prisms? Explain.

THINGS TO REMEMBER

1. *What is a solid.*
2. *What is the unit for measuring capacity.*
3. *How to find the volume of prisms, cylinders, pyramids, and cones.*
4. *The meaning of a "time belt" and how it is determined.*

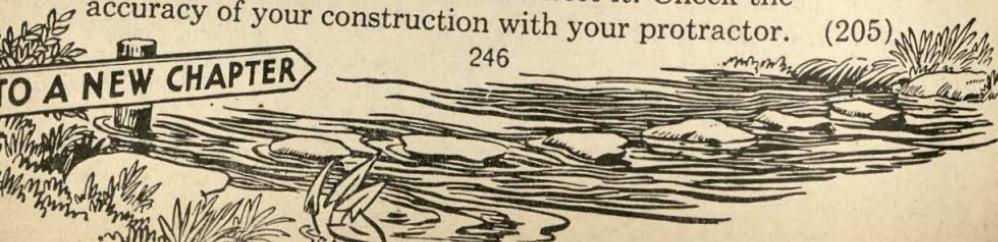
TEST ON CHAPTER X

1. How many faces has a cube?
2. Find the volume of a cube having an edge of 6 inches.
3. A rectangular prism is $8' \times 6' \times 9'$. What is its volume?
4. An aquarium, 21 inches long and 15 inches wide, is filled to a depth of 11 inches. If there are 231 cubic inches in a gallon, how many gallons of water does it contain?
5. A bin, 8 feet deep, has a square base, 6 feet on a side. Allowing .8 of a bushel to a cubic foot, how many bushels will it contain when full?
6. What is the difference between a pyramid and a cone?
7. A pyramid, 6 feet high, has a square base, 2 feet on a side. Find its volume.
8. When it is 5 P.M., Eastern standard time, in New York, what time is it in Denver, which follows Mountain standard time?
9. Is the altitude of the face of a triangular pyramid the same as the altitude of the pyramid? longer? shorter? Why?
10. Soft drinks were sold in a conical-shaped container for 5¢, or in a cylindrical-shaped container for 10¢. The bases and the heights of the containers were the same. Which container was the better buy?

PROGRESS TEST

Solve the problems and perform the indicated operations. If you made errors, turn to the key pages in parentheses where the work is explained.

1. $9\frac{1}{8} + 3\frac{1}{4} + 12\frac{1}{6}$ (14) 8. 409×6008 (9)
2. $4\frac{7}{8} \times 6\frac{1}{4} \times 1\frac{1}{2}$ (16) 9. $27\frac{3}{4} \div 6\frac{1}{2}$ (18)
3. $72.9 \div .27$ (22) 10. $.056 \times 134.5$ (21)
4. $50.4 - 37.8$ (20) 11. $.936 + .058 + .109$ (20)
5. 125% of 475 (65) 12. $\frac{1}{2}\%$ of 760 (72)
6. $84 = ?\%$ of 25 (66) 13. $36 = ?\%$ of 96 (66)
7. $18 = 6\%$ of ? (74) 14. $210 = 70\%$ of ? (74)
15. Round off to the nearest hundredth: a. .725;
b. .495; c. .4495; d. .005; e. .995. (27)
16. It is estimated that there are four million golfers in this country, 16% of whom are women. How many women golfers are in this country? (65)
17. The yearly interest from a loan of \$550 is \$16.50. What is the rate of interest? (108)
18. There are how many days from September 15 to December 1? (119)
19. Name three different kinds of life insurance policies. What is meant by each kind? (160)
20. Find the interest on \$450 at 4% for 36 days. (107)
21. Find the cost of 100 shares of stock selling at $27\frac{3}{4}$, plus \$15 for brokerage. (147)
22. What is meant by liability insurance? (170)
23. A tax rate of 28.6 mills on \$1 is the same as how much on \$100? on \$1000? (187)
24. Construct a regular hexagon having a side of 3 inches. (209)
25. Draw an angle of 48° and bisect it. Check the accuracy of your construction with your protractor. (205)



CHAPTER XII

INDIRECT MEASUREMENT AND SQUARE ROOT

Elsie: "Bill, I weigh 84 pounds."

Bill: "I weigh more than you; I weigh 96 pounds."

1. How much more does Bill weigh than Elsie?

You have compared their weights by **subtraction**. You might have compared Elsie's weight with Bill's weight by **division**, thus: $84 \div 96$, or $\frac{84}{96}$, or $\frac{7}{8}$. Hence, Elsie weighs seven eighths as much as Bill.

Or, you might have compared Bill's weight with Elsie's by division, thus: $96 \div 84$, or $\frac{96}{84}$, or $1\frac{1}{7}$. Hence, Bill weighs $1\frac{1}{7}$ times as much as Elsie.

When two numbers are compared by division, the quotient, as you recall, is their **ratio**.

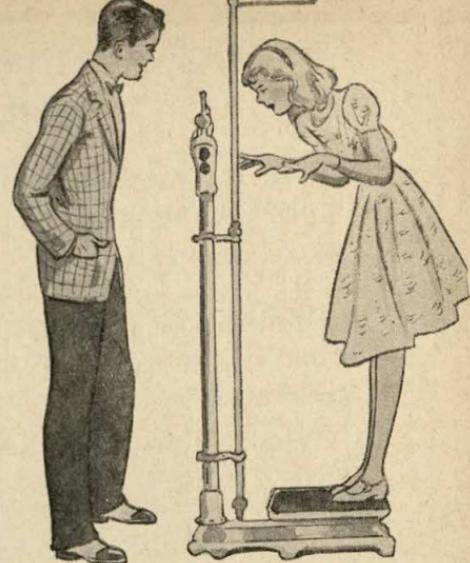
2. What is the ratio of \$2 to \$8?

$$\$2 \div \$8 = \frac{2}{8} = \frac{1}{4}$$
 The ratio of \$2 to \$8 is the same as the ratio of 1 to 4.

3. What is the ratio of \$8 to \$2?

$$\$8 \div \$2 = \frac{8}{2} = \frac{4}{1}$$
 The ratio of \$8 to \$2 is the same as the ratio of 4 to 1.

4. a. What is the ratio of 2 yards to 6 yards? b. of 6 yards to 2 yards? c. of 60 inches to 66 inches? d. of 66 inches to 60 inches? e. of 21 years to 24 years?



WRITING RATIOS

A ratio may be written in three different ways; for example, the ratio of 1 pound to 4 pounds may be written:

a. $1 \div 4$

b. $\frac{1}{4}$

c. $1 : 4$

The third ratio is read, "1 to 4." Sometimes the other two are read in the same way. The colon (:) is often used to express ratio.

1. What is the ratio of 5 years to 15 years?
2. What is the ratio of \$18 to \$36? of \$36 to \$18?
3. Mary has a box 12 inches long, 8 inches wide, and 2 inches high. a. What is the ratio of the width to the height? b. of the length to the height? c. of the length to the width? (The ratio of the length to the width is $12 : 8$ or $\frac{3}{2}$. The result may be left in the fraction form, $\frac{3}{2}$.)
4. Ethel is 12 years of age and her mother is 36 years of age. a. What is the ratio of Ethel's age to the age of her mother? b. of her mother's age to Ethel's age?
5. Old potatoes are selling at 20¢ a peck and new potatoes at 50¢ a peck. a. What is the ratio of the price of old potatoes to the price of new potatoes? b. of the price of new potatoes to the price of old potatoes?
6. For every 2 boys in a certain school, there are 3 girls. a. What is the ratio of the number of boys to the number of girls? b. of the number of girls to the number of boys?
7. There were 500 students and 400 adults at a football game. a. What was the ratio of the number of students to the number of adults? b. of the number of adults to the number of students?
8. Write the ratio of $3 \div 4$ in two other forms.

EXPRESSING RATIOS

1. What is the ratio of 4 inches to 2 feet?

2 ft. = 24 in.

4 in. \div 24 in. = $\frac{1}{6}$, the ratio.

Two quantities must be expressed in the same unit before the ratio between them can be found.

Find the ratios between the following:

2. 2 ft. and 2 yd.

8. 10 da. and 1 wk.

3. 3 qt. and 2 gal.

9. 20 rd. and 1 mi.

4. 5 pk. and 3 bu.

10. 8 hr. and 2 da.

5. 6 oz. and 2 lb.

*11. 15 centimeters and 1 meter

6. 5 pt. and 1 qt.

*12. 2 meters and 30 centimeters

7. 12¢ and \$1

*13. 60 sq. rd. and 1 acre

14. The ratio of the circumference of a circle to the diameter is π . What is the ratio of the circumference to the radius?

15. a. What is the ratio of the perimeter of a square to a side? b. of a side to the perimeter?

16. a. What is the ratio of the perimeter of an equilateral triangle to a side? b. of a side to the perimeter?

17. a. What is the ratio of the perimeter of a regular hexagon to a side? b. of a side to the perimeter?

18. a. What is the ratio of the perimeter of a regular pentagon to a side? b. of a side to the perimeter?

*19. a. What is the ratio of the diameter of a circle to the circumference? b. of the radius to the circumference?

*20. What is the ratio of the area of a 2-inch square to the area of a 4-inch square?

*21. What is the ratio of the volume of a 4-inch cube to the volume of a 2-inch cube?

APPLICATIONS OF RATIO

1. John can ride 7 miles on his bicycle in the same length of time that he can walk 2 miles. How far could he walk in the time it would take him to ride 14 miles?

The ratio of the distance he can walk to the distance he can ride is $\frac{2}{7}$.

Then, $\frac{2}{7} \times 14 = 4$, number of miles he could walk in the time it takes him to ride 14 miles.

2. How far could John ride (problem 1) in the time it takes him to walk 3 miles?
3. Sally can read 40 pages of a book while Ruth is reading 30 pages. At that ratio, how many pages can Ruth read while Sally is reading 120 pages?
4. A baseball team won 6 of its first 11 games. At that ratio, how many games would the team win during a season of 154 games?
5. The radii of two circles are in the ratio of 2 to 3. If the circumference of the first circle is 30 inches, what is the circumference of the second circle?
6. If 3 stamped envelopes cost 10¢, what will be the cost of 18 stamped envelopes at the same rate?
7. When oranges sell at 6 for 17¢, how many can be bought for 51¢?
8. If two grapefruit cost 15¢, what will be the cost of 10 grapefruit?
9. When 3 bars of soap can be bought for 20¢, how many can be bought for \$1 at the same rate?
10. Mrs. Sawyer paid 45¢ for ice cream to serve 6 people. At that rate how much would it cost to serve ice cream to 24 people?

DICTIONARY SCALE DRAWINGS

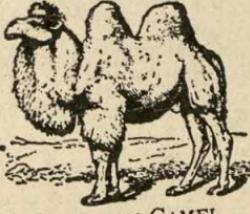
1. Martha saw in her dictionary a drawing of a mountain goat. Beneath it was printed $\frac{1}{36}$. On the same page there was a picture of a mouse with $\frac{1}{4}$ printed close to the animal's body. What did these fractions represent?
2. In the drawing of the mountain goat, the ratio of the size of the drawing to the size of the animal was $\frac{1}{36}$. That is, the average-sized goat is about 36 times the size of the picture in Martha's dictionary. If the drawing is $1\frac{1}{4}$ inches long, what is the length of an average-sized goat?
3. The fraction, $\frac{1}{70}$, was printed beneath the picture of a mule. What does the fraction represent?
4. The dictionary also showed a picture of rock crystal. Below the picture was printed $\times 100$ to indicate the ratio of its size to the size of the crystal. If the picture of the crystal is 0.5 of an inch in diameter, what is the diameter of the crystal?
5. With the picture of a caterpillar is printed the ratio $\times 2\frac{1}{2}$. What does this ratio represent?
6. If a picture is full size, what is the ratio of its size to the size of the object?
7. State what the following represent when used with pictures: $\frac{7}{12}$; $\times 2$; $\frac{1}{50}$; 1; $\times 500$.
- *8. Find a dictionary drawing which gives the ratio of size to the size of the object. Tell what the ratio means.
- *9. Here are dictionary drawings of several animals. About how tall is each animal in real life?

251



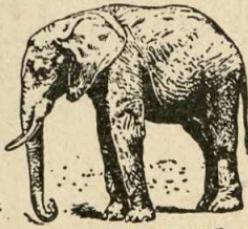
WALRUS

$\frac{1}{80}$



BACTRIAN CAMEL

$\frac{1}{80}$



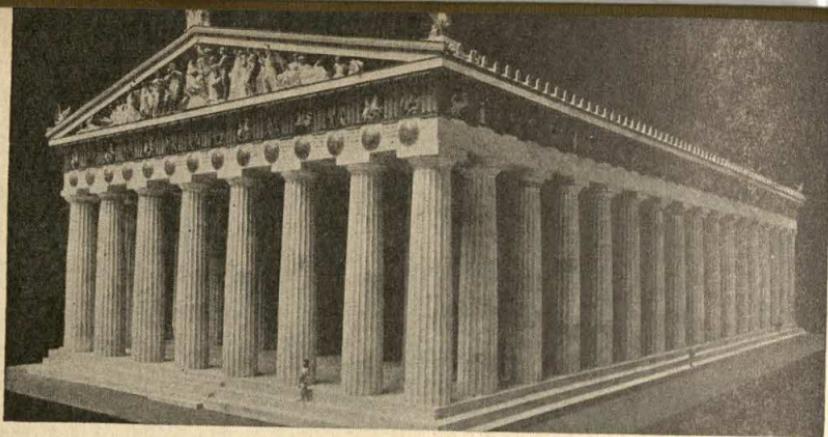
AFRICAN ELEPHANT

$1\frac{1}{25}$



RING-TAILED LEMUR

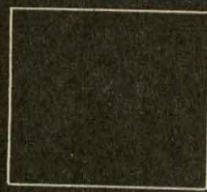
1



The Parthenon as the ancient Greeks saw it.

THE DIVINE PROPORTION

1. Which rectangle is most pleasing to you? Tell why.



Many, *many* years ago, the Greeks tried to find a ratio between width and length most pleasing to the eye. They decided on $\frac{5}{8}$. This relationship, called the **divine proportion**, they used in the building of temples (such as the Parthenon), the making of vases, and in other art work.

2. What is the length of a flag, 10 feet wide, if width and length are in divine proportion?

3. A room is 24 feet long. What should be its width if it is to meet the Greek ideal of divine proportion?

4. Measure a pane in the window of your schoolroom. How nearly does it conform to divine proportion?

- *5. Which of two rectangular rugs more nearly approaches divine proportion: one that measures 9' \times 12', or one that is 11' \times 16'?

APPLICATIONS OF RATIO—CONTINUED

1. In making solder, a manufacturer uses 2 pounds of tin to 3 pounds of lead. How many pounds of each metal would be used in making 25 pounds of this solder?

In every 5 pounds of the mixture, there are 2 pounds of tin and 3 pounds of lead.

The tin represents $\frac{2}{5}$ of the mixture; the lead $\frac{3}{5}$.

$$\frac{2}{5} \times 25 = 10; \quad \frac{3}{5} \times 25 = 15$$

The mixture contains 10 pounds of tin and 15 pounds of lead.

2. In the Fairview School the ratio of boys to girls is as 3 to 4. If the total enrollment is 560, how many boys and how many girls are enrolled?

3. A recipe for making jam calls for 3 pounds of sugar to 4 pounds of berries. How much of each is needed to make 30 pounds of jam?

4. In a town election for mayor, the ratio of the votes for the two candidates was as 3 : 2. If there were 2635 votes cast, how many votes did each candidate receive?

5. A board, 14 feet long, is to be cut into two pieces having the ratio of 3 : 4. What will be the two lengths?

6. The sides of a triangle are in the ratio of 1 : 2 : 2. If the perimeter of the triangle is 25 inches, find the length of each side. (HINT: Find the sum of the ratios. The smallest side will be $\frac{1}{5}$ of the perimeter.)

7. When the ratio between any two sides of a triangle is 1, what kind of a triangle is it?

8. The angles of a triangle are in the ratio 3 : 2 : 4. Find the number of degrees in each angle. (HINT: 180° in the three angles.)

*PROPORTION

The ratio of 1 foot to 2 feet is $\frac{1}{2}$; the ratio of 4 feet to 8 feet is $\frac{4}{8}$ or $\frac{1}{2}$. Then the ratio of 1 : 2 is the same as the ratio of 4 : 8.

Two ratios which are equal to each other form a proportion.

A proportion may be written: $\frac{1}{2} = \frac{4}{8}$, or $1 : 2 = 4 : 8$, or $1 : 2 :: 4 : 8$. No matter what the form, the proportion means that the ratio of 1 to 2 is the same as the ratio of 4 to 8. For brevity this is usually read, "1 is to 2 as 4 is to 8."

Suppose a proportion were incomplete, as $\frac{2}{3} = \frac{?}{6}$. How would the missing number be found?

Change $\frac{2}{3}$ to sixths.

$$\frac{2}{3} \times \frac{2}{2} = \frac{4}{6}$$

(a) Why does $\frac{2}{3} = \frac{4}{6}$?

(b) What was the missing number in the proportion?

Find the missing number in each of the following proportions:

1. $\frac{2}{3} = \frac{?}{9}$

7. $\frac{5}{6} = \frac{25}{?}$

2. $\frac{3}{4} = \frac{?}{8}$

8. $\frac{5}{6} = \frac{?}{36}$

3. $\frac{5}{6} = \frac{10}{?}$

9. $\frac{15}{16} = \frac{?}{64}$

4. $\frac{7}{8} = \frac{21}{?}$

10. $\frac{7}{9} = \frac{42}{?}$

5. $\frac{2}{9} = \frac{?}{18}$

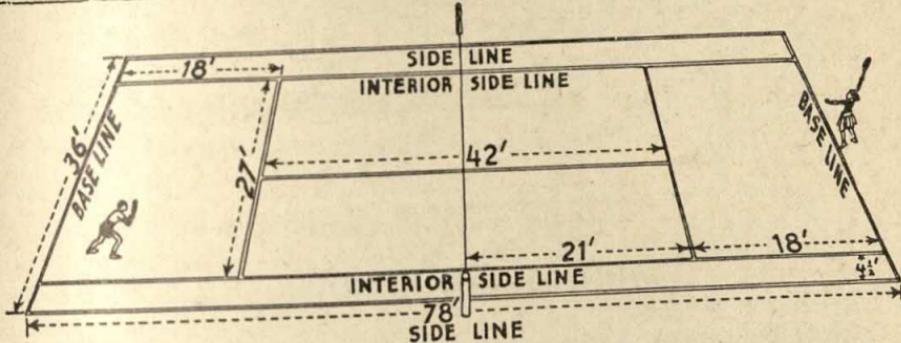
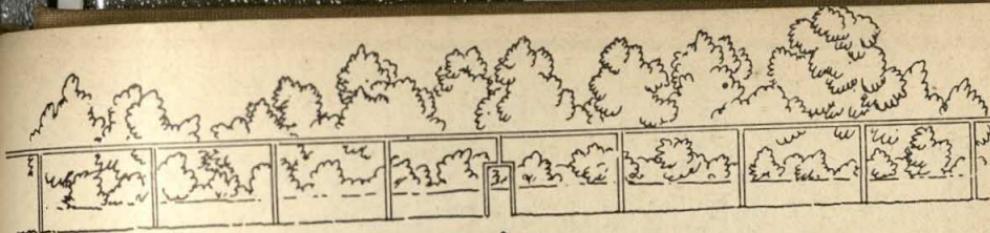
11. $\frac{?}{8} = \frac{15}{24}$

6. $\frac{?}{12} = \frac{10}{24}$

12. $\frac{9}{?} = \frac{27}{48}$

In the proportion $\frac{2}{3} = \frac{4}{6}$, the product of 2 and 6 equals the product of 3 and 4. These two products may be found by cross multiplication $\frac{2}{3} >> \frac{4}{6}$. Hence, $2 \times 6 = 3 \times 4$.

13. Use the missing numbers (examples 1-12), and prove that the two products in each example are equal.



HOW TO LAY OUT A TENNIS COURT TO SCALE

Before a house, an airplane, or any other building or machine is constructed, plans or blueprints of it must be drawn. All parts on the plan are in exact ratio, but smaller in size than the corresponding parts of the object. That is, they are **drawn to scale**.

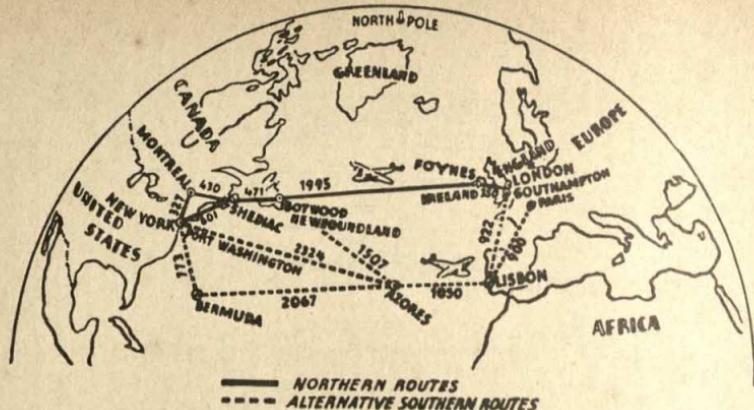
The above diagram shows the official size of a "singles" and a "doubles" tennis court. The part of the court between the two "base lines" and the two "interior side lines" is the playing surface for "singles." The "base lines" and the "side lines" mark the surface for "doubles."

1. Draw to scale, $1'' = 8'$, a tennis court for both "singles" and "doubles."

2. On your diagram, what is the distance between the base lines? between the side lines?

3. A tennis court is enclosed by a fence 20 feet back of each base line and 8 feet from each side line. Draw to scale, $1'' = 16'$, the plot enclosing the court, and a "singles"- "doubles" court.

4. What is the area enclosed by the plot (problem 3)?



AIRWAYS TO EUROPE

Some air routes flown between New York and London are shown on the map. The distances are drawn to scale.

1. a. What is the airline distance from New York to the Azores? b. from the Azores to Lisbon? c. from Lisbon to Southampton? d. from New York to Southampton by the Azores-Lisbon route?
2. What is the distance from New York to Southampton by way of Newfoundland?
3. The distance from Newfoundland to the Azores is about 1500 miles. Measure the distance on the map and determine to what scale the map is drawn.
4. Measure the distance on the map between Bermuda and the Azores and check the scale determined in problem 3. How closely did your two answers (problems 3-4) agree?
- *5. a. Measure the airline distance between the Azores and Southampton. b. How many miles is this, according to scale (problem 3)? c. How many miles can be saved by direct flight, Azores to Southampton, instead of by way of Lisbon?

MEASURING BY USE OF SHADOWS

If you dropped a weighted line from your bedroom window, you could find the distance from sill to ground quite easily by **direct measurement**. If you were asked to find the height of a tree, however, by direct measurement, the job would be much more difficult and somewhat risky.

A safer way to find the height of a tall object is by **indirect measurement**.

1. If a man, 6 feet tall, casts a shadow 8 feet long, what is the height of a flagpole which, at the same time, casts a shadow 40 feet long?

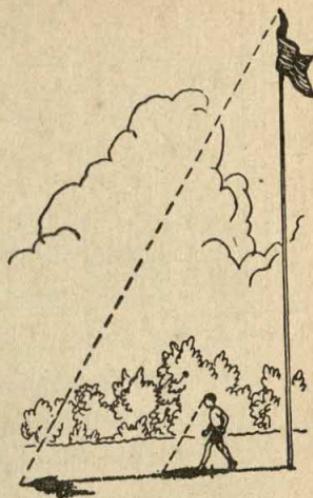
$$\frac{\frac{6}{8}}{\frac{3}{4}} = \frac{3}{4}, \text{ ratio of height of man to his shadow.}$$
$$\frac{3}{4} \times 40 = 30 \text{ feet, the height of the pole.}$$

2. A tree casts a shadow 54 feet long. If, at the same time, a pole, 9 feet high, casts a shadow 6 feet in length, what is the height of the tree?

3. A boy, 5 feet tall, casts a shadow 8 feet long. How high is a nearby building which, at the same time, casts a shadow 476 feet long?

4. If a man, 6 feet tall, casts a shadow 5 feet long, when standing near the Empire State Building, what would be the length, at the same time, of the shadow cast by this tallest building in the world (height 1248 ft.)?

5. A stake, $6\frac{1}{2}$ feet high, casts a shadow 8 feet long. At the same time, a church spire casts a shadow 175 feet long. What is the height of the spire?



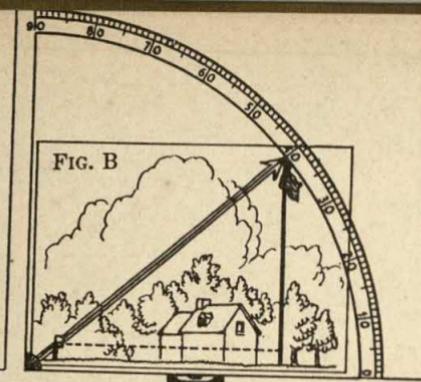


FIG. A

1. A quadrant forms what fractional part of a circle?
2. The pointer moves through how many degrees?
3. The pointer measures an angle of how many degrees?

Suppose your job is to measure the height of a flagpole.

a. Step off, or measure, any distance from the pole, let us say 100 feet. b. Hold the base of your quadrant parallel with the ground or pavement. c. Sight along the pointer to the top of the pole. d. Note the number of degrees in the **angle of elevation** (Fig. B). This angle happens to be 40° , but it might be up to 90° , depending on the height of the object and the distance of the observer from the object. e. Lay off, on ruled paper, a horizontal distance of 100 feet, using any convenient scale, as $1'' = 30'$ (Fig. C). f. Let A be the point of observation, B the foot of the pole, and C the top of the pole. At A , construct an angle of 40° . g. Extend the side AC until it cuts the line BC . The point, C , represents the height of the pole above B . h. Assume that the observer stands $5\frac{1}{2}$ feet to the level of his eye. Give the height of the flagpole in feet.

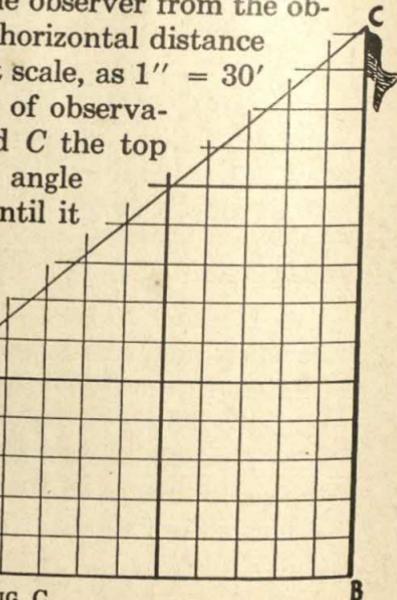


FIG. C

MEASURING BY USE OF SCALE DRAWINGS

The height and certain other dimensions of objects can also be measured fairly accurately by the use of a **quadrant** (Fig. A).

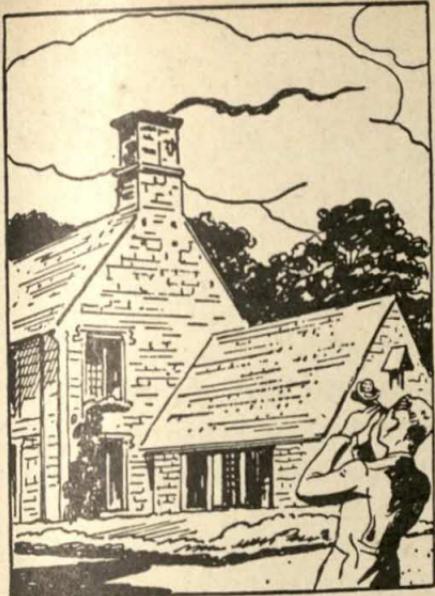


FIG. A



FIG. B

THE CLINOMETER AND TRANSIT

The angle of elevation from any given point to the top of an object may also be measured with a **clinometer**, one form of which is shown in Figure A.

1. The angle of elevation of the top of a building, 75 feet from its base, was found by clinometer to be 30° . What was the height of the building? (Use a scale drawing.)
2. The angle of elevation of the top of a monument, 66 feet from its base, is 45° . Find the height of the monument by scale drawing. Are the height and the horizontal distance the same or different?
3. Some students (Fig. B) are measuring the angle of elevation of the top of their school building with a **transit**. This angle is 54° at 60 feet from the base of the building. By scale drawing, find the height of the building. (Add 5 feet for the height of the transit.)

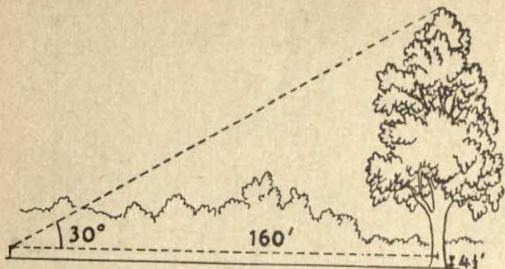


FIG. A

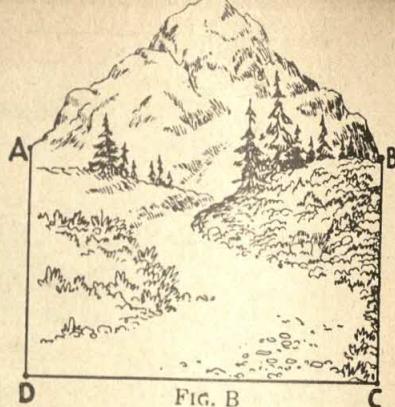


FIG. B

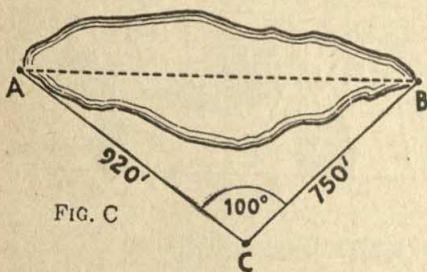


FIG. C

measured $7\frac{1}{2}$ feet, the length of the shadow of a tower was 81 feet. What was the height of the tower?

2. George found the angle of elevation of the top of a tree, at a distance of 160 feet, to be 30° . If his horizontal line of vision was $4\frac{1}{2}$ feet from the ground, what was the height of the tree (Fig. A)?

3. Find the height of a tree when the angle of elevation of the top is 20° at a distance of 180 feet.

4. A surveyor had to find the horizontal distance between points A and B, situated on opposite sides of a hill. He sighted AD and BC as shown (Fig. B), and then measured the line CD. Why are CD and AB the same length?

5. John saw a pond (Fig. C) at the foot of the meadow. He was 920 ft. from one end of the pond (A), and 750 ft. from the other end (B). How wide is the pond, if the angle between A and B and John's station is 100° ?

*APPLICATIONS OF INDIRECT MEASUREMENTS

Solve each of the following problems either by ratio or by scale drawing.

1. When the shadow of a man, 5 feet 10 inches tall,

THE SIDES OF A RIGHT TRIANGLE

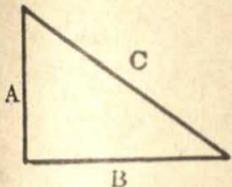


FIG. A

1. What kind of triangle is Figure A?
2. Which side of the triangle is opposite the right angle? This side is called the **hypotenuse**.
3. Which sides form the right angle? These sides are called the **arms** or **legs** of the triangle.

4. How long is the hypotenuse of this triangle? Express the length in quarters of an inch.

5. How long is each leg or arm, expressed in quarters of an inch?

6. Why is a right triangle of this size called "3-4-5 triangle"?

7. In this right triangle each side has been converted into a square and the sides of the squares have been broken into 3, 4, and 5 parts to form smaller squares identical in size. *a.* How many squares are built on the hypotenuse? *b.* On the smaller of the two legs? *c.* On the larger?

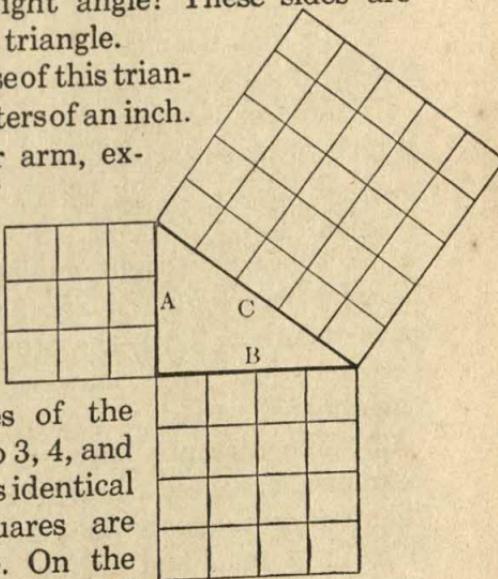
8. How does the number of squares on the hypotenuse compare with the sum of the squares on the other two sides?

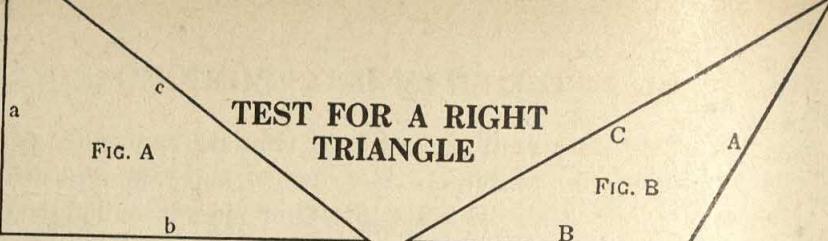
You have discovered for yourself one of the most famous rules in mathematics—the **hypotenuse rule** or the **rule of Pythagoras**.

About 2500 years ago a Greek mathematician, Pythagoras, proved that the **square erected on the hypotenuse of a right triangle equals the sum of the squares of the other two sides**, that is, $H^2(C^2) = B^2 + A^2$.



PYTHAGORAS





TEST FOR A RIGHT TRIANGLE

FIG. A

FIG. B

1. In the triangle (Fig. A) prove that $a^2 + b^2 = c^2$. What kind of triangle is Figure A? Why?

2. In the triangle (Fig. B) does $A^2 + B^2 = C^2$? Is Figure B a right triangle? Why or why not?

Examples 3-10 give the lengths of the sides of 8 triangles. Which of these triangles are right triangles? Why?

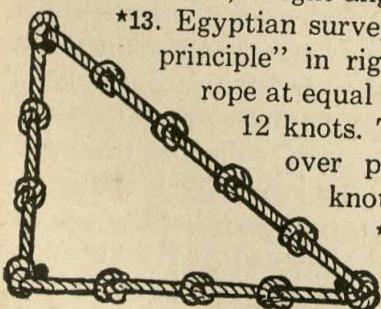
3. 6, 8, 10 5. 12, 16, 20 7. 16, 20, 24 9. 12, 21, 28

4. 4, 6, 8 6. 5, 12, 13 8. 7, 24, 25 10. 14, 48, 50

11. To form a right angle, carpenters often measure a board 6 feet long and another 8 feet long and fasten two ends together. Then the other two ends are fastened by a board 10 feet long. Show why a right angle is formed by this means.

*12. The distance between any two bases of a baseball diamond is 90 feet. Show how you could lay out a baseball diamond with a tape measure and three measuring sticks, 9 feet, 12 feet, and 13 feet in length. The angle at each base is, of course, a right angle.

*13. Egyptian surveyors made use of "the 3-4-5 principle" in right triangles. They knotted a rope at equal intervals until they had made 12 knots. Then they stretched the rope over pegs as shown. How many knots are on each side?



*14. Knot a 12-foot string at intervals of one foot. Lay out a right triangle by the Egyptian method.

SQUARE ROOT AND ITS MEANING

1. Esther was planning to buy a suitcase, inside length 24 inches, width 10 inches. She wanted to know whether her umbrella, 27 inches long, could be placed diagonally in the suitcase. Her brother said the umbrella would not fit in the case. Was he correct or not?

The case was rectangular in shape. Hence, the length of the diagonal can be found from the formula

$$c^2 = a^2 + b^2 \quad c^2 = 576 + 100 = 676$$

He knew that $26 \times 26 = 676$.

$c = 26$, no. of inches in the length of the diagonal.

Therefore Esther could not put an umbrella, 27 inches long, in a suitcase 10 inches by 24 inches.

In mathematics 26 is called the **square root** of 676 because $26 \times 26 = 676$.

The **square root** of a given number is the number which multiplied by itself produces the given number.

2. The square root of a number may be indicated by the sign $\sqrt{}$. Thus, $\sqrt{64}$ is read, "the square root of 64." What is $\sqrt{64}$?

3. A number whose exact square root can be found is called a **perfect square**. Hence, 25 is a perfect square, but 24 is not a perfect square. Why?

4. State which of the following numbers are perfect squares:

a. 1; b. 2; c. 4; d. 10; e. 12; f. 36; g. 50; h. 100.

5. Write the squares of all the numbers from 1 to 9, inclusive.

6. Ruth has a square piece of paper, 1 foot on a side. How many square inches does it contain?

FINDING SQUARES AND SQUARE ROOTS

On page 265 is a table showing the square and square root of every number from 1 to 150. The roots of numbers not perfect squares can only be approximated. In the table their values are given to the nearest hundredth.

1. Find the square of: *a.* 16; *b.* 68; *c.* 3.9; *d.* 108; *e.* 14.6; *f.* 1.37; *g.* 1.25; *h.* 1.08.
2. Find the square root of: *a.* 3; *b.* 14; *c.* 64; *d.* 92; *e.* 113; *f.* 140; *g.* 109; *h.* 147.
3. Find the square root of 1225. (HINT: Find 1225 in the column of squares. What is its square root?)
4. Find the square root of: *a.* 3364; *b.* 7396; *c.* 12,321; *d.* 16,900; *e.* 19,044; *f.* 12,996; *g.* 18,769.
5. Find the square root of 6.76.

The square root of 676 is 26. Therefore, the square root of 6.76 is 2.6. By inspection you can tell that the value must be between 2 and 3 because $2 \times 2 = 4$ and $3 \times 3 = 9$. 6.76 is between 4 and 9.

6. Find the square root of: *a.* 14.44; *b.* 33.64; *c.* 79.21; *d.* 1.1236; *e.* 1.6384; *f.* 190.44; *g.* 213.16.
7. The side of a square is 7.8 inches. What is its area?
8. The area of a square is 46.24 square feet. What is its side?
- *9. The perimeter of a square is 17.2 inches. What is its area?
- *10. If the area of a circle is 81π , what is the radius?
- *11. If the area of a circle is 144π , what is the radius? the diameter?

TABLE OF SQUARES AND SQUARE ROOTS

N	N^2	\sqrt{N}	N	N^2	\sqrt{N}	N	N^2	\sqrt{N}
1	1	1.00	51	2,601	7.14	101	10,201	10.05
2	4	1.41	52	2,704	7.21	102	10,404	10.10
3	9	1.73	53	2,809	7.28	103	10,609	10.15
4	16	2.00	54	2,916	7.35	104	10,816	10.20
5	25	2.24	55	3,025	7.42	105	11,025	10.25
6	36	2.45	56	3,136	7.48	106	11,236	10.30
7	49	2.65	57	3,249	7.55	107	11,449	10.34
8	64	2.83	58	3,364	7.62	108	11,664	10.39
9	81	3.00	59	3,481	7.68	109	11,881	10.44
10	100	3.16	60	3,600	7.75	110	12,100	10.49
11	121	3.32	61	3,721	7.81	111	12,321	10.54
12	144	3.46	62	3,844	7.87	112	12,544	10.58
13	169	3.61	63	3,969	7.94	113	12,769	10.63
14	196	3.74	64	4,096	8.00	114	12,996	10.68
15	225	3.87	65	4,225	8.06	115	13,225	10.72
16	256	4.00	66	4,356	8.12	116	13,456	10.77
17	289	4.12	67	4,489	8.19	117	13,689	10.82
18	324	4.24	68	4,624	8.25	118	13,924	10.86
19	361	4.36	69	4,761	8.31	119	14,161	10.91
20	400	4.47	70	4,900	8.37	120	14,400	10.95
21	441	4.58	71	5,041	8.43	121	14,641	11.00
22	484	4.69	72	5,184	8.49	122	14,884	11.05
23	529	4.80	73	5,329	8.54	123	15,129	11.09
24	576	4.90	74	5,476	8.60	124	15,376	11.14
25	625	5.00	75	5,625	8.66	125	15,625	11.18
26	676	5.10	76	5,776	8.72	126	15,876	11.23
27	729	5.20	77	5,929	8.78	127	16,129	11.27
28	784	5.29	78	6,084	8.83	128	16,384	11.31
29	841	5.39	79	6,241	8.89	129	16,641	11.36
30	900	5.48	80	6,400	8.94	130	16,900	11.40
31	961	5.57	81	6,561	9.00	131	17,161	11.45
32	1,024	5.66	82	6,724	9.06	132	17,424	11.49
33	1,089	5.74	83	6,889	9.11	133	17,689	11.53
34	1,156	5.83	84	7,056	9.17	134	17,956	11.58
35	1,225	5.92	85	7,225	9.22	135	18,225	11.62
36	1,296	6.00	86	7,396	9.27	136	18,496	11.66
37	1,369	6.08	87	7,569	9.33	137	18,769	11.71
38	1,444	6.16	88	7,744	9.38	138	19,044	11.75
39	1,521	6.24	89	7,921	9.43	139	19,321	11.79
40	1,600	6.33	90	8,100	9.49	140	19,600	11.83
41	1,681	6.40	91	8,281	9.54	141	19,881	11.87
42	1,764	6.48	92	8,464	9.59	142	20,164	11.92
43	1,849	6.56	93	8,649	9.64	143	20,449	11.96
44	1,936	6.63	94	8,836	9.70	144	20,736	12.00
45	2,025	6.71	95	9,025	9.75	145	21,025	12.04
46	2,116	6.78	96	9,216	9.80	146	21,316	12.08
47	2,209	6.86	97	9,409	9.85	147	21,609	12.12
48	2,304	6.93	98	9,604	9.90	148	21,904	12.17
49	2,401	7.00	99	9,801	9.95	149	22,201	12.21
50	2,500	7.07	100	10,000	10.00	150	22,500	12.25

APPROXIMATE SQUARE ROOTS

1. From the table (page 265), find the approximate square root of 741.

741 is not in the table. But 741 is between 729 and 784, both of which are perfect squares and are in the table.

The $\sqrt{729}$ is 27, and the $\sqrt{784}$ is 28.

741 is less than halfway between 729 and 784; hence, the square root of 741 is between 27.0 and 27.5.

The squares of 27.1, 27.2, and 27.3 are shown.

$$27.1^2 = 734.41$$

$$27.2^2 = 739.84$$

$$27.3^2 = 745.29$$

The square root of 741, to the nearest tenth, is 27.2.

2. Between what two numbers in the table is 4513? To which of these numbers is it closer?

3. Between what two numbers in the table is 9337? To which of these numbers is it closer?

4. Between what two numbers in the table is 5838? To which of these numbers is it closer?

Find, to the nearest tenth, the square root of:

5. 483 6. 1865 7. 4343 8. 7000

*9. A square has an area of 163.84 square inches. What is the length of a side?

The side must be between 12 inches and 13 inches. Why? The exact value can be read from the table in the column of squares for three-place numbers.

*10. A square has an area of 210.25 square feet. What is the length of a side?

*11. Find, to the nearest tenth, the length of the side of a square which has an area of 154.36 square inches.

APPROXIMATE SQUARE ROOTS BY DIVISION

If you do not have a table of squares and square roots, you can find the approximate square root of a number by division.

1. Find by division the approximate square root of 1856.

The square root of 1856 is between 40 and 50, because $40^2 = 1600$ and $50^2 = 2500$.

As 1856 is nearer to 1600 than to 2500, try 43 as a divisor.

When 1856 is divided by 43, the quotient to the nearest hundredth is 43.16.

The approximate square root of 1856 is the average of the divisor and quotient, or

$$\frac{43 + 43.16}{2} = \frac{86.16}{2} = 43.08$$

To the nearest tenth, the approximate square root is 43.1.

Check: $43.1 \times 43.1 = 1857.61$

2. If the square root to be found were midway between 40^2 and 50^2 , what number would be used as a divisor?

3. Between what two values is the square root of:

a. 72	b. 130	c. 790	d. 2732
e. 5144	f. 6198	g. 8950	h. 9124

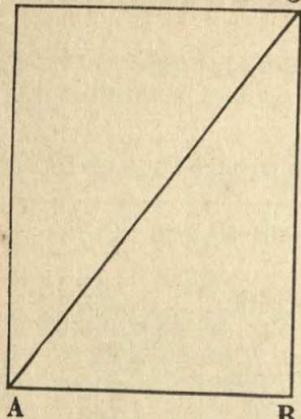
Using the division method, find to the nearest tenth the approximate square root of each of the following numbers:

4. 50	7. 1340	10. 3285	13. 7025
5. 180	8. 1492	11. 5100	*14. 80.34
6. 670	9. 2131	12. 6000	*15. 24.27

D

C

FINDING THE HYPOTENUSE



1. A rectangle is 15 feet wide and 20 feet long. What is the length of its diagonal?

ABC is a right triangle.

AC = H (Hypotenuse)

Then $H^2 = 15^2 + 20^2$. Why?

$H^2 = 225 + 400$. Explain.

$$H^2 = 625$$

$H = 25$. Explain.

2. A baseball diamond is 90 feet on a side. Find the distance between home plate and second base.

3. What is the distance between first and third bases?

4. A corner lot in a city is 100 feet square. How much shorter is it to walk diagonally across the lot than around two of the sides? (Express the result to the nearest foot.)

5. A school is located at the intersection of two roads. If Mary's home is 3 miles due north of the school, and Ethel's home is 4 miles due west of the school, what is the shortest distance between these two homes?

6. If the only way to travel from one home to the other (problem 5) is to pass the school, how much longer is this route than the airline route between the two homes?

7. To the nearest tenth, find the length of the diagonal of rectangles having the following dimensions:

LENGTH	WIDTH	LENGTH	WIDTH	LENGTH	WIDTH
a. 14	8	d. 8	5	g. 5	3
b. 26	15	e. 16	9	h. 35	25
c. 25	20	f. 15	12	i. 72	54

*FINDING ANY SIDE OF A RIGHT TRIANGLE

1. In the triangle shown, you know that $c^2 = a^2 + b^2$. Write the formula for b^2 ; for a^2 .

2. The hypotenuse of a right triangle is 13 inches and one of the legs is 12 inches. How long is the other leg?

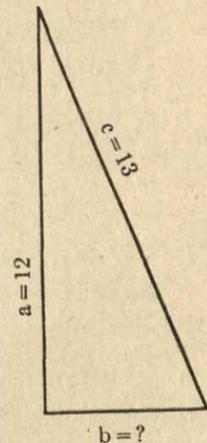
Let $c = 13$ $b^2 = c^2 - a^2$, the formula

$$a = 12 \quad b^2 = 13^2 - 12^2$$

$$b = ? \quad b^2 = 169 - 144, \text{ or } 25$$

$b = 5$. Explain.

The missing dimension is 5 inches.



3. The hypotenuse of a right triangle is 10 feet and one leg is 8 feet. How long is the other leg?

4. If a and b are the legs and c the hypotenuse of a right triangle, find the missing values in the following triangles:

	5.	6.	7.	8.	9.	10.
$a =$	6	?	12	?	10	?
$b =$	8	5	?	10	10	24
$c =$	?	13	16	20	?	30

11. The altitude of an isosceles triangle bisects its base. If the equal sides of the triangle are 14 inches and the base is 8 inches, what is the altitude of the triangle? the area?

*12. Select the best answer to the following puzzle: A flat surface is 1 mile in length. At each end of the surface is fastened the end of a string 1 foot longer than the surface (5281 feet). If the middle of the string is raised vertically above the surface until the string is taut, the highest point on the string above the surface is:

a. 6 in.; b. 1 ft.; c. 6 ft.; d. 50 ft.; e. 100 ft.



HOW WELL DO YOU REMEMBER?

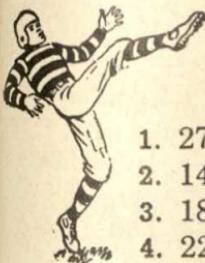


1. What is the ratio of 3 feet to 6 feet? of 6 feet to 3 feet?
2. Write the ratio of \$5 to \$8 in two different ways.
3. What is the ratio of the side of a square to the perimeter? of the perimeter to a side?
4. When new potatoes sell at 3 pounds for 14¢, find the cost of 1 peck (15 pounds).
5. If Sam can read 5 pages in 8 minutes, how long will it take him to read 40 pages at the same rate?
6. What is meant by "divine proportion"? Which of the following rectangles has the ratio of its sides most nearly approaching the Greek ideal: *a.* $9' \times 12'$? *b.* $8' \times 10'$? *c.* $6' \times 10'$? *d.* $5' \times 6'$? *e.* $11'' \times 19''$?
7. If a map is drawn to a scale $1'' = 50$ miles, find the distance between two cities, $2\frac{1}{2}$ inches apart on the map.
8. A blueprint is made to the scale $1'' = 16'$. Find the dimensions on the blueprint of a building lot $50' \times 120'$.
9. At a distance of 100 feet from the foot of a flagpole, the angle of elevation of the top of the pole is 30° . By a scale drawing, find the height of the flagpole.
10. State which of the following represent the sides of a right triangle: *a.* 3, 4, 5; *b.* 7, 9, 10; *c.* 7, 24, 25.
11. Square each number: 1, 9, 10, 16, 33, 99.
12. Copy the following sentence and insert the missing numbers: The square of a one-figure number contains either ? or ? figures; the square of a two-figure number contains either ? or ? figures.
13. How many figures are in the square root of: *a.* 9? *b.* 144? *c.* 9025? *d.* 11,025? *e.* 64? *f.* 122,500?

USING THE VOCABULARY OF ARITHMETIC

Define each term given below or use it correctly in a sentence. If you do not know the meaning of a term, turn to the key page in parentheses.

angle of elevation	(258)	legs of a right triangle	(261)
direct measurement	(257)	ratio	(247)
divine proportion	(252)	perfect square	(263)
indirect measurement	(257)	square root	(263)
hypotenuse rule	(261)	scale drawing	(255)



LET'S PRACTICE

14

a

1. 27.5% of 360
2. $14 = ?\%$ of 70
3. $18 = 12\%$ of ?
4. 225% of 360
5. Change to per cents: a. $\frac{1}{8}$; b. .01; c. 4; d. $2\frac{1}{2}$.
6. Change to decimals: a. 8% ; b. $\frac{1}{2}\%$; c. 90% ; d. 110% .
7. To the nearest hundredth, find the value of: a. $\frac{6}{7}$; b. $\frac{7}{9}$;
c. $\frac{5}{8}$; d. $\frac{3}{11}$; e. $\frac{5}{16}$; f. $\frac{2}{9}$.

b

155% of 390

$150 = ?\%$ of 25

$5 = 5\%$ of ?

$30 = 2\%$ of ?

c

*TOPICS FOR SPECIAL REPORTS

1. Show how a housewife uses ratios in following recipes.
2. Make a scale drawing of your classroom.
3. Show how indirect measurement is used in: a. astronomy; b. warfare; c. navigation.
4. Draw three right triangles of different sizes, each containing an acute angle of 31° . Find the ratio of the legs in each triangle and see if these ratios are the same.
5. Show that the sum of the odd numbers in order, beginning with 1 + 3, will always be a perfect square.

THINGS TO REMEMBER

1. *What ratio is and how to use it.*
2. *How to copy figures to a given scale.*
3. *How to find heights and other unknown dimensions by indirect measurement.*
4. *How to find the approximate square root of any number.*
5. *How to use the Pythagorean rule.*

TEST ON CHAPTER XI

1. Find the ratio between: *a.* 3 yards and 8 yards; *b.* 6 inches and 2 feet; *c.* 45 minutes and 2 hours.
2. The distance between bases on a baseball diamond is 90 feet. What is the ratio of the distance between any two bases and the distance around the diamond?
3. If 4 oranges cost 15¢, how much will 24 oranges cost at the same rate?
4. A baseball team played 14 games and won 9. What was the ratio of the number of games won to the number of games lost? of the number of games lost to the number of games won?
5. Morton found the picture of a gnu in his dictionary. The fraction, $\frac{1}{45}$, was written below the picture. What did the fraction represent?
6. The floor of the basketball court in the Madison Gym measures $50' \times 80'$. Make a scale drawing of the floor using the scale $1'' = 8'$.
7. What is a 3-4-5 triangle? What kind of a triangle is it?
8. Two triangles have sides: *a.* 5 in., 12 in., 13 in.; *b.* 6 in., 9 in., 12 in. Which is a right triangle? Why?
9. To the nearest tenth, find the approximate square root of 41.

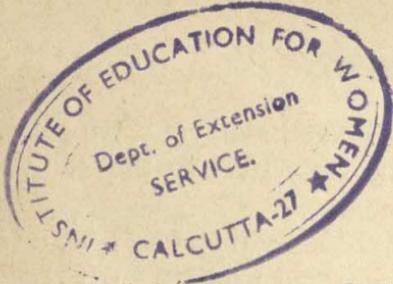
PROGRESS TEST

Solve the following problems. Then have your paper scored. If you made errors on the test, turn to the key pages in parentheses for help.

1. To three decimal places, find the standing of a baseball team which played 35 games and won 19. (27)
2. A grocer bought a crate containing 216 oranges for \$1.75. If he sold the oranges at 20¢ a dozen, what was his margin? (83)
3. The grocer's expenses (problem 2) were 15% of his sales. What was his profit? The profit was what per cent of the selling price? (83)
4. A certain postage stamp measures $0.75'' \times 0.87''$. What are the dimensions of a rectangular sheet of 100 such stamps, if there are 10 stamps on each edge of the sheet? (21)
5. A mortgage of \$6500 is to be repaid in $18\frac{1}{2}$ years at the rate of \$47 a month. The amount paid in monthly instalments is how much greater than the amount of the loan? (135)
6. A used car sold for \$250 cash, or \$80 down and \$24 a month for 8 months. What was the interest charge for buying on the instalment plan? (110)
7. A \$1000 bond was purchased for $92\frac{1}{2}$. At how much less than its face value was this? (141)
8. Hidden taxes represent at least 25% of the cost of many purchases. At that rate, find the amount of the hidden taxes on a suit which cost \$37. (65)
9. A property, worth \$6500, is assessed at 60% of its value. At a tax rate of \$2.19 on \$100, find the annual tax on the property. (187)
10. What is the ratio of a quart to a gallon? (249)



TO A NEW CHAPTER



CHAPTER XII

INCREASING YOUR KNOWLEDGE OF ALGEBRA

Harry had twice as much money as Robert and together they had \$2.25. How much money had each?

SOLVE BY ARITHMETIC

If Harry had twice as much money as Robert, then Harry had $\frac{2}{3}$ of the amount which both had, and Robert had $\frac{1}{3}$.

$$\frac{1}{3} \text{ of } \$2.25 = \$0.75$$

$$\frac{2}{3} \text{ of } \$2.25 = \$1.50$$

SOLVE BY ALGEBRA

Let x = number of cents
Robert had
and $2x$ = number of cents
Harry had

$$\text{Then } 3x = 225$$

$$(\text{since } \$2.25 = 225\text{¢})$$

$$x = 75$$

$$2x = 150$$

Robert had \$0.75

Harry had \$1.50

Which do you think is the easier way of solving the problem: by arithmetic or by algebra? Why?

To solve problems by algebra, you must become familiar with the tools of algebra. In your study of the formula you learned how letters are used to represent numbers. One of the very useful tools of algebra is the **equation**. In this chapter you will learn more about equations and how to use them in solving problems.

FINDING A MISSING NUMBER

Joan wrote three numbers on the blackboard and covered one of the numbers with a board eraser. Then she asked the class to tell what number was missing.

Bill said, "We must think, 'What number added to 5 will give 9?' This number is 4."

Find the missing numbers:

1. $5 + ? = 12$

2. $7 + ? = 15$

3. $? + 10 = 16$

4. $20 = 12 + ?$

5. $3 \times ? = 24$

6. $36 = ? \times 9$

7. $9 \times ? = 81$

8. $5 - ? = 3$

9. $? - 4 = 13$

10. $\frac{?}{3} = 8$

11. $10 = \frac{?}{4}$

12. $\frac{?}{7} = 9$

Instead of using a question mark to represent the missing number, the class decided to let n stand for the number to be found.

Walter wrote: $n + 3 = 9$. "In your example, Walter," said Joan, " n stands for 6, because $6 + 3 = 9$."

Find the value of n in each of the following:

13. $3n = 12$

14. $8n = 24$

15. $n + 7 = 9$

16. $n + 1 = 12$

17. $n - 6 = 8$

18. $n - 9 = 30$

19. $\frac{1}{2}n = 5$

20. $\frac{1}{4}n = 8$

21. $n - 5 = 20$

22. $6n = 42$

23. $n + 4 = 18$

24. $\frac{1}{5}n = 6$

25. $n - 1 = 9$

26. $n + 1 = 9$

27. $\frac{1}{3}n = 4$

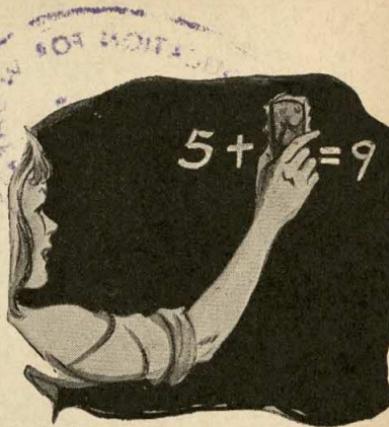
28. $\frac{1}{5}n = 2$

29. $5 = n + 1$

30. $18 = 2n$

Statements, as in examples 13-30, are called equations.

An equation shows that two things are equal. At least one of the numbers in an equation is represented by a letter. The equation, $n + 4 = 7$, shows that " $n + 4$ " and "7" are equal, and the missing number is represented by the letter " n ."



THE LANGUAGE OF ALGEBRA

When you begin to study a new subject, you must learn the vocabulary, or language, of that subject. Algebra has its language. In algebra, for example, you may use n , x , or any other letter to represent a number. Read each of the following statements. Then note how the words of each statement are changed into the language of algebra.

STATEMENT	ALGEBRAIC FORM
1. Twice a number increased by 5.	$2n + 5$
2. A number decreased by 4.	$n - 4$
3. Half of a number increased by 3.	$\frac{1}{2}n + 3$
$\left(\frac{n}{2} \text{ and } \frac{1}{2}n \text{ are the same}\right)$	or $\frac{n}{2} + 3$

Write in the language of algebra: (Let n represent the number for problems 4-10; x , for problems 11-18.)

4. Four times a number.
5. A number increased by 8.
6. A number decreased by 6.
7. Four times a number increased by 12.
8. Ten times a number decreased by 2.
9. One third of a number.
10. Half of a number decreased by 5.
11. One fourth of a number increased by 7.
12. A number plus twice the number.
13. Twice a number decreased by 14.
14. Half of a number increased by 16.
15. Three times a given amount increased by 4.
- *16. A number plus one third of the number.
- *17. A number decreased by one fourth of the number.
- *18. Half of a number decreased by one third of the number.

BUILDING EQUATIONS

In the following statements one thing is equal to another thing, so the statements may be written as equations.

STATEMENT	EQUATION
1. A number increased by 9 is 14.	$n + 9 = 14$
2. Twice a number decreased by 4 is 6.	$2n - 4 = 6$
3. Half of a number increased by 5 is 11.	$\frac{1}{2}n + 5 = 11$

Write equations for the following:

4. A number decreased by 6 is 10.
5. A number multiplied by 3 is 24.
6. A number divided by 6 is 3.
7. Four times a number decreased by 5 is 15.
8. If 4 is taken from a number, the remainder is 12.
9. Five times a number increased by 6 is 21.
10. Three times a number less 4 is 24.
11. Five times a number less 15 is zero.
12. One fourth of a number is 8.
13. Half of a number less 3 is 5.
14. One third of a number plus 1 is 13.
15. Twelve is equal to a number plus 4.
16. Two is equal to twice a number less 3.
17. What number divided by 4 is equal to 6?
18. What number decreased by 3 is equal to 8?
- *19. One third of a number less one fourth of it is 1.
- *20. Half of a number plus one fourth of it is 6.
- *21. Twice a number decreased by 7 is equal to the number itself.
- *22. One third of a number increased by 6 is equal to five times the number.



PROPERTIES OF EQUATIONS

Just as balance scales have two pans, one on either side of the center support, so equations have two parts, called **members**, one on either side of the sign of equality. **Both members of an equation are equal.**

In the equation, $x + 4 = 7$, one member is " $x + 4$," and the other is " 7 ."

Read each member in each of the following equations:

a. $n - 6 = 15$; b. $23 = 2y - 5$; c. $\frac{b}{6} = 4$; d. $36 = 4z + 5$.

When one member of an equation is changed, the other member must be changed in like manner.

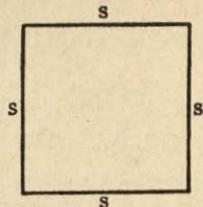
Certain rules or axioms govern work with equations.

- a. If equals are added to equals, the sums are equal.
- b. If equals are subtracted from equals, the remainders are equal.
- c. If equals are multiplied by equals, the products are equal.
- d. If equals are divided by equals, the quotients are equal.

These four rules may be combined into one rule which may be called the **Golden Rule of Equations**:

Whatever you do to one member of an equation, you must do to the other also.

SOLVING EQUATIONS BY THE DIVISION RULE



1. The perimeter of a square is 24 inches.
What is the length of a side?

The formula for the perimeter of a square is $p = 4s$.
By substituting 24 for p , we get the equation

$$24 = 4s$$

Divide both members by 4. This gives $\frac{24}{4} = \frac{4s}{4}$,

or $6 = s$

The length of a side is 6 inches. Check: $24 = 4 \times 6$

Solve and check the following equations:

2. $2n = 18$ 5. $5a = 45$ 8. $7c = 42$ 11. $8x = 56$

3. $54 = 9y$ 6. $72 = 9t$ 9. $4m = 92$ 12. $7a = 133$

4. $210 = 5r$ 7. $2g = 81$ 10. $3x = 55$ 13. $8y = 1.68$

14. If three quarts of milk cost 42¢, what is the cost of one quart?

Let $x =$ the cost of one quart

The equation $3x = 42$

Dividing both

members by 3, $x = 14$

The cost was 14¢ a quart. Check: $3 \times 14 = 42$

To solve problems by algebra, proceed as follows:

- a. Find what is asked in each problem.
- b. State the problem in the form of an equation.
- c. Solve the equation. Then check it.

15. At what rate an hour must a car travel in order to go a distance of 140 miles in 4 hours?

SOLVING EQUATIONS BY THE SUBTRACTION RULE

1. The length of a rectangle is 5 feet greater than the width. If the length is 8 feet, what is the width?

Let

$$w = \text{no. of feet in width}$$

and

$$w + 5 = \text{no. of feet in length}$$

Then, the equation

$$w + 5 = 8$$

Subtract 5 from both

members

$$\begin{array}{r} 5 = 5 \\ - w \end{array}$$

This gives

$$w = 3$$

The width is 3 feet.

Check: $3 + 5 = 8$, substituting 3 for w .

Solve and check the following equations:

2. $x + 12 = 20$ 6. $9 + x = 10$ 10. $13 = 6 + r$

3. $n + 3 = 10$ 7. $t + 9 = 9$ 11. $24 = 18 + s$

4. $a + 13 = 20$ 8. $23 = 15 + k$ 12. $n + 2\frac{3}{4} = 7$

5. $y + 1\frac{1}{2} = 6$ 9. $n + 3.6 = 13$ 13. $n + 5.1 = 11.2$

14. There are 5 more boys than girls in a class. If there are 19 boys, find the number of girls.

15. Henry has 3 more dimes than nickels. If he has 7 nickels, how many dimes does he have?

16. A farmer had 12 more Holstein cows than Jersey cows. He had 33 Holstein cows. How many Jerseys had he?

17. On a street there are 9 more elm trees than maple trees. If there are 12 elm trees, what is the number of maples?

18. Jane has 143 more stamps than Alice has. If Jane has 927 stamps, how many does Alice have?

19. Mr. Rice's salary is \$175 more this year than last year. If his present salary is \$1825, what was his salary last year?

SOLVING EQUATIONS—MULTIPLICATION RULE

1. If a quarter pound of cheese costs 8¢, find the cost of one pound at the same rate.

Let $x = \text{the cost of one pound}$
Then $\frac{x}{4}$ or $\frac{1}{4}x$ ($\frac{x}{4} = \frac{1}{4}x$) = the cost of $\frac{1}{4}$ of a pound
The equation $\frac{x}{4} = 8$
Multiply both members
by 4 $4 \times \frac{x}{4} = 4 \times 8$
This gives $x = 32$
The cost was 32¢ a pound. Check: $32 \div 4 = 8$

Solve and check the following:

2. $\frac{m}{4} = 6$ 5. $\frac{x}{5} = 9$ 8. $\frac{s}{4} = 15$ 11. $\frac{t}{2} = 4.8$
3. $\frac{r}{9} = 7$ 6. $\frac{z}{3} = 4\frac{1}{3}$ 9. $\frac{f}{2} = 0$ 12. $4 = \frac{p}{5}$
4. $\frac{y}{10} = .1$ 7. $\frac{u}{4} = 5.3$ 10. $.54 = \frac{n}{3}$ 13. $\frac{m}{100} = 8.7$

14. A farmer sold $\frac{1}{3}$ of his crop of oats for \$175. At that rate, what was the value of the whole crop?

15. A family spends $\frac{1}{5}$ of its income for rent. If the rent is \$45 a month, what is the monthly income?

16. One eighth of a number is 27. What is the number?

17. Mr. Scott paid his income tax in quarterly payments. If each payment was \$34.58, what was his total income tax?

*18. Mrs. Martin bought a refrigerator on the instalment plan. If her monthly payment was \$16 for 8 months, what was the cost of the refrigerator? (Each payment = $\frac{1}{8}$ of cost.)

*19. Mrs. Reed bought a car on the instalment plan. She made a cash payment and the remainder in 12 equal monthly instalments of \$48.50. What was the amount paid in monthly instalments?

SOLVING EQUATIONS BY THE ADDITION RULE

1. A dealer in used cars sold 6 cars in one week and then had 15 cars left. How many cars did he have at the beginning of the week?

Let x = the number of cars he had at first

and $x - 6$ = the number of cars remaining after 6 were sold

The equation $x - 6 = 15$

Add 6 to both

members of

the equation $6 = 6$

This gives $x = 21$

The dealer had 21 cars.

Check: $21 - 6 = 15$, substituting 21 for x .

Solve and check the following:

2. $x - 4 = 13$	6. $y - 8 = 17$	10. $m - 6 = 35$
3. $24 = y - 7$	7. $54 = n - 9$	11. $19 = x - 1$
4. $h - 6 = 0$	8. $z - 2 = 3\frac{1}{2}$	12. $h - 2\frac{1}{4} = 4\frac{1}{2}$
5. $r - .7 = 1.5$	9. $p - 1.5 = 7.5$	13. $y - 2.5 = 0$

14. Jim sold his knife for 40¢, which was 35¢ less than he paid for it. Find the cost.

15. At the close of a football game, one of the players weighed 174 pounds. He had lost 6 pounds during the game. What was his weight before the game?

16. A farmer sold some wheat for 72¢ a bushel, which was 12¢ below the market price a month later. What was the market price on the later date?

17. After Milton spent \$2.85 for a pair of skates, he had \$1.96 left. How much did he have at first?

USING MULTIPLICATION AND DIVISION RULES

In some equations, both the multiplication and division rules must be used to complete the solution.

1. If $\frac{3}{4}$ of a pound of butter costs 27¢, find the cost of one pound at the same rate.

Let $x = \text{the cost of one pound}$

Then $\frac{3x}{4} = \text{the cost of } \frac{3}{4} \text{ of a pound}$

The equation $\frac{3x}{4} = 27$

Multiplying both members by 4 $3x = 108$

Dividing both members by 3 $x = 36$

The cost is 36¢ a pound. Check: $\frac{3}{4}$ of 36¢ = 27¢.

Solve the following equations:

$$2. \frac{2x}{3} = 10$$

$$6. \frac{3a}{5} = 12$$

$$10. \frac{4n}{7} = 8$$

$$3. \frac{3h}{2} = 10$$

$$7. \frac{5b}{2} = 12$$

$$11. \frac{7n}{8} = 14$$

$$4. \frac{9x}{4} = 36$$

$$8. \frac{2n}{3} = 15$$

$$12. 12 = \frac{3x}{4}$$

$$5. \frac{9y}{10} = 90$$

$$9. \frac{2h}{5} = 15$$

$$13. 36 = \frac{2a}{3}$$

14. If $\frac{3}{4}$ of a yard of ribbon costs 18¢, what is the cost of one yard?

- *15. If $1\frac{1}{2}$ pounds of steak cost 54¢, what was the cost of one pound? ($1\frac{1}{2} = \frac{3}{2}$)

- *16. If $3\frac{1}{2}$ yards of ribbon cost \$1.05, what was the price of one yard?

- *17. If $1\frac{3}{4}$ gallons of anti-freeze for the radiator of an automobile cost \$3.50, what is the cost of one gallon?

- *18. The cost of $2\frac{3}{4}$ yards of cloth for a dress was \$3.30. What was the cost of one yard?

FINDING A MISSING LETTER IN A FORMULA

1. Martha's garden is rectangular and contains 36 square feet. If the garden is 9 feet long, how wide is it?

Formula for area of a rectangle: $A = lw$
Substituting the given values in the formula: $36 = 9w$
Dividing both members by 9: $4 = w$
The width is 4 feet. Check: $36 = 9 \times 4$.

Find the missing dimensions in these rectangles:

2. $A = 24$ sq. ft., $l = 6$ ft., $w = ?$
3. $A = 90$ sq. ft., $w = 6$ ft., $l = ?$
4. Find the altitude of a triangle which has a base of 9 inches and an area of 36 square inches.

Formula for area of a triangle: $A = \frac{bh}{2}$
Substituting the given values in the formula: $36 = \frac{9h}{2}$
Multiplying both members by 2: $72 = 9h$
Dividing both members by 9: $8 = h$
The altitude is 8 inches. Check: $36 = \frac{1}{2} \times 9 \times 8$.

Using the formula $A = \frac{1}{2}bh$, find the missing letters:

5.	6.	7.	8.	9.	10.
$A =$	12	15	48	56	?
$b =$	6	5	?	7	9
$h =$	?	?	12	?	12

*11. Using the formula $C = \pi d$, if $C = 22$, find d ; if $C = 154$, find d . ($\pi = \frac{22}{7}$)

*12. Using the formula $V = lwh$, if $V = 144$, $l = 8$, and $w = 6$, find h .

PRACTICE IN SOLVING EQUATIONS

Set I

1. $x - 3 = 5$	6. $5x = 60$	11. $72 = 4a$
2. $n + 8 = 12$	7. $\frac{a}{4} = 15$	12. $36 = \frac{y}{5}$
3. $b - 15 = 18$	8. $3 = \frac{m}{4}$	13. $15 = x + 6$
4. $40 = 8a$	9. $720 = 5c$	14. $a + 40 = 50$
5. $\frac{u}{4} = 20$	10. $90 = 4s$	15. $n - 18 = 31$

Set II

1. $5x = 80$	6. $n - 3\frac{1}{2} = 2\frac{1}{4}$	11. $n + 5\frac{1}{2} = 7$
2. $3.68 = 8x$	7. $a + 2\frac{1}{3} = 4\frac{5}{6}$	12. $6p = 5.4$
3. $\frac{n}{7} = 18$	8. $\frac{2n}{3} = 8$	13. $\frac{3t}{4} = 15$
4. $\frac{5x}{6} = 30$	9. $\frac{4s}{5} = 20$	14. $\frac{6h}{7} = 24$
5. $p + 3\frac{1}{4} = 12\frac{1}{2}$	10. $\frac{2a}{5} = 40$	15. $72 = \frac{3x}{4}$

Set III

1. Use the formula for the area of a rectangle:
 - a. If $A = 72$ and $l = 16$, find w .
 - b. If $A = 216$ and $w = 9$, find l .
2. Use the formula for the area of a triangle:
 - a. If $A = 48$ and $h = 16$, find b .
 - b. If $A = 72$ and $b = 18$, find h .
3. Use the formula for the volume of a prism:
 - a. If $V = 144$, $l = 8$, and $w = 3$, find h .
 - b. If $V = 360$, $l = 8$, and $h = 6$, find w .
4. Use the formula for the volume of a pyramid:
 - a. If $V = 36$ and $B = 12$, find h .
 - b. If $V = 120$ and $h = 18$, find B .
- *5. Use the formula for the area of a square:
 - a. If $A = 625$, find s .
 - b. If $A = 1296$, find s .



DEATH VALLEY—MT. WHITNEY

The car in the picture is at Bad Water in Death Valley, California, which is 279.6 feet below sea level.

The picture on page 287 shows the same car at the end of the road, 8371 feet up Mt. Whitney.

The road sign might have read, "Bad Water, -279.6 feet." The elevation above sea level of the end of the road on Mt. Whitney might be written +8371 feet.

The **minus sign** before 279.6 indicates that the place is **below sea level**; the **plus sign** before 8371 indicates that the place is **above sea level**.

Write 50 feet below sea level; 5000 feet above sea level.

Readings of temperature from a thermometer may also be written with plus or minus signs. When you say that the temperature of your classroom should be 70° , you mean 70° above zero. This may be written $+70^{\circ}$.

Very often the plus sign is omitted before a positive number. The minus sign must always be written.



1. Using plus to represent above zero, and minus to represent below zero, write:

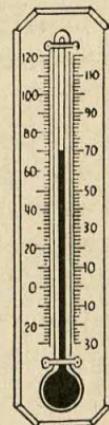
a. 25° above zero	e. 1° below zero
b. 14° below zero	f. 1° above zero
c. 95° above zero	g. 65° above zero
d. 3° above zero	h. 10° below zero

2. The freezing point for water is 32° above zero. Write this temperature. Did you choose the plus or the minus sign?

3. Write the temperature when the thermometer registers zero degrees.

When the **plus sign** is written before a number, the number is a **positive number**.

When the **minus sign** is written before a number, the number is a **negative number**. Positive and negative numbers are called **signed numbers**.



NUMERICAL OR ABSOLUTE VALUE

You found (page 287) that positive and negative numbers are called signed numbers. The amount of change between two numbers is the **numerical or absolute value** of the signed numbers. Thus, a change in temperature from 40° to 50° is 10° . This change is positive because it shows that the temperature rose 10° .

A change in temperature from 45° to 35° is 10° . This change is negative because it shows that the temperature dropped 10° . In each case the change is 10° .

When the temperature goes up 10° , the amount of the change is $+10^{\circ}$; when the temperature goes down 10° , the amount of the change is -10° . Thus, both $+10^{\circ}$ and -10° have the numerical or absolute value of 10° ; but the signs tell that these amounts are in opposite directions.

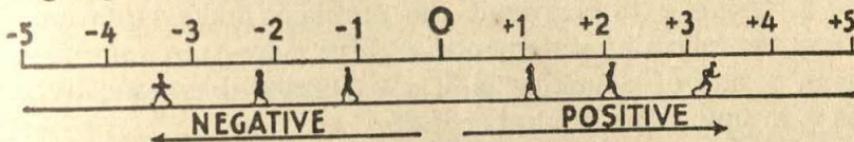
The numerical or absolute value of a signed number is the number without the sign.

1. What is the numerical or absolute value of $+16$? of -3 ? of $+40$? of -1 ? of -16° ? of $+3^{\circ}$? of $+1^{\circ}$?
2. Write as signed numbers:

a. positive 6	d. negative 1
b. negative 30	e. positive 100°
c. positive 1	f. negative 20°
3. Mr. Smith earned \$24 one week and \$30 another week. What is the absolute difference between the two amounts? Consider earning as positive and write this difference with a signed number.
4. A football team advanced the ball 4 yards by rushing; then a forward pass gained 12 yards more. Write the total gains with a signed number.
5. A football team gained 5 yards and then lost 5 yards by a penalty. Write these amounts with signed numbers.

SIGNED NUMBERS ON A HORIZONTAL SCALE

A scale in a horizontal position may also be used to indicate signed numbers. Numbers to the left of a zero point usually are considered negative and those to the right positive.



1. If you walk 1 mile in a positive direction and then walk 2 miles more in the same direction, how far do you walk? Indicate your position on the scale.
2. If you walk 2 miles in a negative direction and then go 1 mile more in that direction, how far do you walk? Indicate your position on the scale.
3. If you walk 4 miles in a positive direction and then walk 1 mile in a negative direction, how many miles do you walk? Indicate your position on the scale. You are now how far from your starting position?
4. If you walk 2 miles in a positive direction and then 2 miles in a negative direction, how far do you walk? Indicate your position on the scale.
5. When $+2$ and -2 are added the result is zero. Zero does not have the same meaning when used with signed numbers that it has in arithmetic. Zero used with signed numbers means that there has been **no change**. If you gain 3 pounds in weight and then lose 3 pounds, you are back to your original weight. What does zero mean in this case?
6. Show how you could represent a gain of 3 pounds and then a loss of 3 pounds on the number scale given above.



HOW WELL DO YOU REMEMBER?

1. Using n to represent the number, write the following statements in the language of algebra: *a.* five times a number; *b.* a number decreased by 6; *c.* a number increased by 8; *d.* one third of a number.

2. Using x to represent the number, make equations from the following statements: *a.* three more than a number is 8; *b.* half of a number is 7; *c.* a number decreased by 5 is 9; *d.* four times a number is 28.

3. Solve the equations which you made in problem 2.
Solve and check the following:

4. $x - 5 = 8$ 7. $n + 3 = 15$ 10. $14 = 8 + n$

5. $\frac{x}{9} = 12$ 8. $7x = 84$ 11. $56 = 8a$

6. $a - 43 = 5$ 9. $\frac{2a}{3} = 12$ 12. $\frac{3a}{4} = 72$

13. Using the formula $A = bh$: if $A = 56$ and $b = 8$, find h .

14. Using the formula $V = lwh$: if $V = 360$, $l = 12$, and $h = 6$, find w .

15. Using the formula $A = \frac{1}{2}bh$: if $A = 24$, and $h = 8$, find b .

16. Express the following as signed numbers: *a.* a gain of 15¢; *b.* a loss of 25¢; *c.* 6° below zero.

17. Robert saw an advertisement which stated that 1 gallon of antifreeze will protect the radiator of an automobile to a temperature of -20° . What is meant by -20° ?

18. Give the absolute value of the following: *a.* +3; *b.* -14; *c.* +65; *d.* -4° .

19. In scoring a game John said he was 500 "in the hole." Using signed numbers, how could he have stated his score?

20. What does zero mean in signed numbers?

THINGS TO REMEMBER

1. How to write a statement in the language of algebra.
2. How to make an equation.
3. How to solve certain kinds of equations.
4. How to solve for a missing letter in a formula.
5. The meaning and some uses of signed numbers.

TEST ON CHAPTER XII

1. Using n to represent the number, write the following statements in the language of algebra: *a.* a number decreased by 5; *b.* three times a number; *c.* a number increased by 12.
2. Using y to represent the number, write equations for the following: *a.* six times a number is 48; *b.* a number decreased by 6 is 8; *c.* a number increased by 3 is 15; *d.* three fourths of a number is 18.
3. Solve the equations you made in problem 2.
4. Using the formula $p = 4s$, if $p = 64$, find s .
5. Using the formula $A = bh$; if $A = 96$ and $b = 12$, find h .
6. Using the formula $V = Bh$; if $V = 216$ and $h = 9$, find B .
7. If gain is positive and loss is negative, write with signed numbers a gain of \$5 and a loss of \$3.
8. If a football team gains 9 yards and is then penalized 5 yards, what is the net gain? Using signed numbers, write the given amounts.
9. What is the absolute value of -5 ? of $+16$? of -10° ?
10. The temperature one evening was two degrees below zero; the next morning it was five degrees below zero. Write these amounts as signed numbers. How much colder was it in the morning than on the previous evening?

PROGRESS TEST IN PROBLEM SOLVING

Solve the following problems and have your paper marked. If you made errors on this test, turn to the key pages in parentheses for help.

1. In a class of 25 students there are 14 girls. What per cent of the class is girls? is boys? (66)
2. If the base of a triangle is 12 inches and its altitude is 9 inches, what is its area? (40)
3. Find the volume of a cylinder 14 feet in diameter and 36 feet high. (Use $\pi = \frac{22}{7}$) (232)
4. A suit was sold for \$36 at a margin of 35% of the selling price. What was the cost of the suit? (84)
5. Using s to represent the side, write the formula for the perimeter of an equilateral triangle; of a regular pentagon; of a regular hexagon. (42)
6. How many days are in the interval from March 15 to July 1? (119)
7. An oil burner is sold for \$325 cash or \$15 down and \$9.75 a month for 36 months. What interest was charged for the privilege of instalment buying? (110)
8. Two numbers are in the ratio of 5 : 6. If the larger number is 54, what is the smaller number? (250)
9. Grapefruit sell 5 for 23¢. At that rate, what will be the cost of 20 grapefruit? (250)
10. At a distance of 75 feet from the base of a chimney, the angle of elevation of the top is 34° . By scale drawing, find the height of the chimney. (258)
11. A man had a yearly income of \$360 from money invested at 3%. How much did he have invested at that rate? (74)
12. The edge of a cube is 4 inches. What is the volume of the cube? (229)

PROGRESS TEST

Perform the indicated operations. If you make errors, turn to the key pages in parentheses where the work is explained.

1. $7\frac{2}{3} + 1\frac{5}{6} + 3\frac{1}{2} + 9\frac{1}{4} = ?$ (14)
2. $7000 - 1092 = ?$ (8)
3. $2534 \div 29 = ?$ (12)
4. $.5616 \div 5.4 = ?$ (22)
5. From $7\frac{1}{8}$ subtract $3\frac{5}{6}$. Check your solution. (14)
6. $56 \times 438 = ?$ (9)
7. $9.6 \times 2.04 = ?$ (21)
8. $3\frac{1}{4} \times 4\frac{1}{2} = ?$ (16)
9. $2.405 - 0.958 = ?$ (20)
10. If 30% of a number is 45, what is the number? (74)
11. 3% of \$750 = ? (65)
12. $\frac{1}{2}\%$ of \$1450 = ? (72)
13. $100 = ?\%$ of 40 (66)
14. $1 = ?\%$ of 200 (66)
15. 5 is 2% of ? (74)
16. 42 is 10% of ? (74)
17. Round off the following to the nearest hundred: a. 638; b. 14,376; c. 50,999; d. 449. (26)
18. Square: a. 76; b. 4.5; c. .25. (264)
19. Find the interest on \$450 at 4% for 36 days. (107)
20. Find A in the formula $A = \frac{1}{2}h(a + b)$ when $h = 16$, $a = 15$, and $b = 24$. (47)
21. Find the approximate square root of 1524. (266)
22. Draw a line 3 inches long and bisect it. (205)
23. What number multiplied by itself equals 225? (265)
24. Solve and check the equation $\frac{2x}{3} = 24$. (283)
25. In the formula $V = Bh$, if $V = 120$ and $B = 24$, find h . (230)

TABLES FOR REFERENCE

Linear Measure or Measures of Length

12 inches (in.)	= 1 foot (ft.)
3 feet	= 1 yard (yd.)
5.5 yards	= 1 rod (rd.)
320 rods	
or	
1760 yards	
or	
5280 feet	
1 mile	= 1 mile (mi.)
	= 1.61 kilometers

Square Measure or Measures of Surface

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
30.25 square yards	= 1 square rod (sq. rd.)
160 square rods	= 1 acre (A.)
640 acres	= 1 square mile (sq. mi.)

Cubic Measure or Measures of Volume

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet	= 1 cubic yard (cu. yd.)
128 cubic feet	= 1 cord of wood of 4-ft. length

Important Volume Equivalents

1 cubic foot	= 7.5 gallons (gal.)
1 cubic foot of water	= 62.5 pounds (lb.)
1 cubic foot	= 0.8 bushel (bu.)
1 gallon	= 231 cubic inches (cu. in.)

Measures of Weight

16 ounces (oz.)	= 1 pound (lb.)
100 pounds	= 1 hundredweight (cwt.)
2000 pounds	= 1 ton (T.)

Liquid Measures

4 gills (gi.)	= 1 pint (pt.)
16 fluid oz.	= 1 pint
2 pints	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)
31.5 gallons	= 1 barrel (bbl.)

2 pints (pt.)	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)
8 quarts	= 1 peck (pk.)
4 pecks	= 1 bushel (bu.)
2½ bushels	= 1 barrel (bbl.)

Dry Measures

10 millimeters (mm.)	= 1 centimeter (cm.), about .4 inch
10 centimeters	= 1 decimeter (dm.), about 4 inches
10 decimeters	= 1 meter (m.), nearly 40 inches (39.37)
1000 meters	= 1 kilometer (km.), about $\frac{2}{3}$ mile

REMEDIAL EXERCISES

Table of Multiplication and Division Facts

The products are found by multiplying the numbers at the top of the columns by each number at the left margin.

If each product is divided by the number in its row on the left margin, the quotient will be the number at the top of the column in which the product is found.

	0	1	2	3	4	5	6	7	8	9
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

Addition of Whole Numbers

I.	a	b	c	d	e	f	g	h	i	j	k	l	m	n
	5	3	1	2	5	1	5	5	7	3	1	5	6	3
	7	5	4	9	7	8	3	4	2	4	4	6	3	9
	8	9	9	4	0	7	7	4	9	3	0	5	5	1
	1	4	6	8	4	9	9	9	4	8	7	8	9	4
	4	7	3	5	9	6	2	7	3	7	6	4	0	8
	6	1	8	6	3	3	6	6	8	6	9	7	8	5

II.	a	b	c	d	e	f	g	h	i	j
	54	29	44	28	58	23	36	37	46	59
	38	18	77	76	60	83	29	73	53	44
	72	60	99	54	97	69	18	29	90	72
	96	45	88	32	40	74	70	92	28	80
	75	39	66	90	71	48	55	81	56	67

III.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
	508	632	736	451	448	382	142	438
	756	108	209	327	376	196	387	196
	349	429	328	964	201	645	960	481
	478	763	157	805	984	528	542	723
	223	548	692	432	538	156	789	645
	<u>194</u>	<u>954</u>	<u>405</u>	<u>198</u>	<u>616</u>	<u>749</u>	<u>150</u>	<u>157</u>

IV.	423	203	96	405	3725	8	903	2758
	56	108	1423	95	946	34	6408	146
	502	706	56	7216	87	729	506	309
	76	1403	9	304	5	1258	807	85
	9	708	145	87	64	635	905	1458
	<u>471</u>	<u>502</u>	<u>32</u>	<u>543</u>	<u>948</u>	<u>74</u>	<u>601</u>	<u>76</u>

Subtraction of Whole Numbers

I.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
1.	432	561	714	735	541	317	452	372
	<u>118</u>	<u>147</u>	<u>152</u>	<u>128</u>	<u>128</u>	<u>173</u>	<u>191</u>	<u>147</u>
2.	531	437	448	916	519	643	543	816
	<u>141</u>	<u>182</u>	<u>182</u>	<u>192</u>	<u>138</u>	<u>124</u>	<u>170</u>	<u>125</u>
II. 1.	621	417	734	511	854	912	641	765
	<u>138</u>	<u>259</u>	<u>186</u>	<u>213</u>	<u>196</u>	<u>327</u>	<u>389</u>	<u>197</u>
2.	547	915	475	811	642	314	547	672
	<u>389</u>	<u>429</u>	<u>197</u>	<u>455</u>	<u>456</u>	<u>198</u>	<u>189</u>	<u>195</u>
III. 1.	760	501	703	580	600	801	504	700
	<u>382</u>	<u>428</u>	<u>209</u>	<u>107</u>	<u>302</u>	<u>108</u>	<u>205</u>	<u>111</u>
2.	370	502	410	304	702	916	430	504
	<u>190</u>	<u>106</u>	<u>154</u>	<u>196</u>	<u>102</u>	<u>108</u>	<u>102</u>	<u>196</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
IV. 1.	328	506	712	403	761	46	1204	316
	72	9	8	9	95	7	8	58

2.	700	504	324	492	1400	901	61	371
	3	8	87	78	29	18	7	98

V.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
1.	4254	9176	7402	5601	1930	8750	2805
	4184	9090	7318	5509	1872	8743	2796

2.	5070	7432	6030	8102	5434	7092	4094
	4081	7084	5092	7066	5398	7087	4079

VI. 1.	3000	8000	6002	5010	6010	4000	7000
	1258	1070	1003	1019	909	1927	28
2.	7090	1000	7050	3000	5700	5005	6000
	2095	23	4098	901	4001	4009	5902
3.	40001	50104	80003	50105	10001	57000	30303
	3008	1094	70095	40109	909	47009	606

Multiplication of Whole Numbers

I.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
1.	56	42	531	697	876	963	471	388
	7	8	4	5	6	9	8	7

2.	987	469	387	459	839	594	689	764
	2	8	9	7	6	9	3	8

II. 1.	408	706	9004	1005	809	903	505	307
	3	7	5	6	7	9	4	8
2.	5002	1902	409	301	7001	9008	509	604
	2	8	9	8	7	7	8	9

III.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
1.	726	498	546	397	684	756	429	542
	20	60	10	50	80	90	70	30
2.	684	761	936	483	694	761	598	869
	40	80	90	70	800	300	900	700
IV. 1.	836	439	508	907	536	372	408	509
	209	407	508	709	102	609	803	608
	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>		
2.	3004	7004	4261	6035	9087	32456		
	206	8006	8001	407	7009	20304		
V.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
1.	670	930	540	610	430	990	870	490
	480	760	290	750	430	740	360	870
	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	
2.	840	180	290	740	9640	8070	6090	
	370	420	300	900	2070	3090	4080	
VI.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	
1.	\$9.27	\$8.56	\$4.27	\$9.48	\$5.14	\$9.08	\$7.59	
	56	97	238	196	807	356	846	
2.	963	5698	6941	7635	5096	7498	5487	
	479	875	981	674	352	986	873	

Division with a One-figure Divisor

I.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1. 4)2293	6)3452	9)8749	8)7867	7)5989	
2. 5)3476	8)4776	7)69568	6)4757	8)9987	

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
II.	1. $9\overline{)2012}$	$7\overline{)31352}$	$7\overline{)3001}$	$6\overline{)5019}$	$7\overline{)6012}$
	2. $7\overline{)4031}$	$9\overline{)21211}$	$7\overline{)5100}$	$8\overline{)2215}$	$9\overline{)31121}$
	3. $8\overline{)50300}$	$6\overline{)4101}$	$9\overline{)4220}$	$8\overline{)21431}$	$7\overline{)6124}$
III.	1. $5\overline{)7545}$	$4\overline{)9232}$	$6\overline{)37248}$	$2\overline{)3780}$	$9\overline{)7650}$
	2. $7\overline{)51138}$	$8\overline{)9645}$	$3\overline{)81295}$	$6\overline{)96090}$	$5\overline{)4900}$
IV.	1. $4\overline{)2963}$	$5\overline{)3604}$	$7\overline{)3715}$	$2\overline{)7401}$	$9\overline{)6666}$
	2. $2\overline{)9800}$	$7\overline{)5044}$	$9\overline{)3158}$	$6\overline{)84365}$	$9\overline{)72816}$
	3. $9\overline{)9817}$	$8\overline{)96360}$	$7\overline{)35496}$	$6\overline{)96181}$	$8\overline{)2004}$

Division with a Two-or-more-figure Divisor

I.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
	1. $23\overline{)496}$	$46\overline{)1954}$	$56\overline{)3465}$	$97\overline{)7004}$	$73\overline{)3156}$
	2. $24\overline{)538}$	$33\overline{)1066}$	$53\overline{)2389}$	$76\overline{)3220}$	$44\overline{)2379}$
	3. $43\overline{)2754}$	$95\overline{)6038}$	$93\overline{)4876}$	$65\overline{)2925}$	$86\overline{)5427}$
II.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	
	1. $23\overline{)4715}$	$42\overline{)17031}$	$73\overline{)66228}$	$31\overline{)39872}$	
	2. $66\overline{)39872}$	$98\overline{)69193}$	$27\overline{)2943}$	$89\overline{)80564}$	
	3. $97\overline{)4850}$	$78\overline{)3900}$	$45\overline{)4320}$	$63\overline{)1460}$	
III.	1. $96\overline{)9072}$	$38\overline{)3654}$	$76\overline{)7154}$	$86\overline{)8235}$	
	2. $47\overline{)4405}$	$39\overline{)3704}$	$58\overline{)5549}$	$44\overline{)40052}$	
	3. $78\overline{)70678}$	$58\overline{)54092}$	$75\overline{)7095}$	$58\overline{)52548}$	

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
IV.	1. $48\overline{)1642}$	$67\overline{)4935}$	$57\overline{)2784}$	$88\overline{)6853}$
	2. $38\overline{)3434}$	$86\overline{)2597}$	$49\overline{)1785}$	$64\overline{)32437}$
	3. $68\overline{)7354}$	$78\overline{)5280}$	$43\overline{)3610}$	$87\overline{)6023}$
V.	1. $24\overline{)1842}$	$26\overline{)2337}$	$27\overline{)1728}$	$39\overline{)1628}$
	2. $29\overline{)1308}$	$84\overline{)7230}$	$99\overline{)6935}$	$58\overline{)36708}$
	3. $28\overline{)1835}$	$59\overline{)4232}$	$27\overline{)1823}$	$69\overline{)3637}$
VI.	1. $14\overline{)972}$	$13\overline{)654}$	$17\overline{)8540}$	$19\overline{)3584}$
	2. $12\overline{)9482}$	$14\overline{)7856}$	$16\overline{)9125}$	$17\overline{)5168}$
	3. $16\overline{)64325}$	$13\overline{)9114}$	$18\overline{)4256}$	$19\overline{)37254}$
VII.	1. $412\overline{)9467}$	$518\overline{)34279}$	$613\overline{)17569}$	$318\overline{)11468}$
	2. $927\overline{)20548}$	$604\overline{)27538}$	$709\overline{)91486}$	$320\overline{)6400}$
	3. $540\overline{)10819}$	$403\overline{)120907}$	$630\overline{)396807}$	$120\overline{)49080}$
VIII.	1. $134\overline{)7128}$	$265\overline{)8496}$	$374\overline{)18523}$	$691\overline{)4478}$
	2. $281\overline{)8437}$	$290\overline{)18763}$	$182\overline{)14635}$	$983\overline{)83560}$
	3. $372\overline{)82680}$	$165\overline{)77559}$	$368\overline{)29440}$	$150\overline{)90060}$

Addition of Fractions

I.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
1.	$\frac{3}{4}$	$\frac{5}{6}$	$\frac{4}{9}$	$\frac{11}{12}$	$9\frac{5}{8}$	$9\frac{1}{4}$	$7\frac{1}{6}$
	$\underline{\frac{3}{4}}$	$\underline{\frac{5}{6}}$	$\underline{\frac{8}{9}}$	$\underline{\frac{7}{12}}$	$\underline{6\frac{1}{8}}$	$\underline{4\frac{1}{4}}$	$\underline{8\frac{1}{6}}$
2.	$\frac{7}{10}$	$\frac{11}{12}$	$\frac{3}{8}$	$\frac{4}{9}$	$6\frac{1}{9}$	$3\frac{5}{8}$	$9\frac{5}{16}$
	$\underline{\frac{9}{10}}$	$\underline{\frac{5}{12}}$	$\underline{\frac{5}{8}}$	$\underline{\frac{5}{9}}$	$\underline{4\frac{5}{9}}$	$\underline{8\frac{3}{8}}$	$\underline{3\frac{7}{16}}$

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
II. 1.	$\frac{1}{4}$	$\frac{3}{4}$	$\frac{5}{6}$	$\frac{2}{5}$	$1\frac{3}{4}$	$5\frac{1}{4}$	$1\frac{3}{10}$
	$\frac{5}{8}$	$\frac{11}{12}$	$\frac{2}{3}$	$\frac{7}{10}$	$2\frac{1}{8}$	$4\frac{1}{2}$	$4\frac{2}{5}$
2.	$\frac{5}{16}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{7}{12}$	$9\frac{1}{4}$	$4\frac{7}{8}$	$2\frac{5}{6}$
	$\frac{7}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{2}{3}$	$7\frac{5}{12}$	$3\frac{1}{16}$	$9\frac{1}{12}$
III. 1.	$\frac{1}{2}$	$\frac{4}{5}$	$\frac{2}{3}$	$\frac{3}{4}$	$8\frac{1}{2}$	$9\frac{1}{4}$	$5\frac{1}{4}$
	$\frac{2}{3}$	$\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{5}$	$4\frac{1}{3}$	$7\frac{2}{3}$	$\frac{1}{3}$
2.	$\frac{3}{4}$	$\frac{2}{3}$	$\frac{4}{5}$	$\frac{3}{4}$	$9\frac{1}{2}$	$\frac{4}{9}$	$7\frac{1}{3}$
	$\frac{2}{5}$	$\frac{5}{8}$	$\frac{5}{6}$	$\frac{4}{5}$	$8\frac{1}{5}$	$3\frac{1}{2}$	$8\frac{1}{4}$
IV. 1.	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{5}{9}$	$\frac{3}{8}$	$2\frac{1}{4}$	$7\frac{3}{4}$	$2\frac{1}{8}$
	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{1}{6}$	$\frac{5}{6}$	$8\frac{1}{6}$	$\frac{1}{6}$	$3\frac{1}{6}$
2.	$\frac{7}{9}$	$\frac{7}{8}$	$\frac{3}{8}$	$\frac{7}{10}$	$8\frac{1}{9}$	$7\frac{3}{8}$	$6\frac{1}{10}$
	$\frac{5}{6}$	$\frac{5}{12}$	$\frac{11}{12}$	$\frac{5}{6}$	$5\frac{1}{6}$	$\frac{5}{12}$	$\frac{5}{6}$
V. 1.	$4\frac{2}{3}$	$9\frac{4}{5}$	$7\frac{1}{3}$	$8\frac{3}{4}$	$6\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{8}{9}$
	$1\frac{3}{4}$	$6\frac{1}{2}$	$\frac{3}{4}$	$4\frac{3}{5}$	$7\frac{2}{3}$	$4\frac{3}{5}$	$9\frac{1}{2}$
2.	$1\frac{5}{8}$	$6\frac{3}{4}$	$9\frac{4}{7}$	$3\frac{6}{7}$	$7\frac{2}{3}$	$9\frac{1}{2}$	$5\frac{8}{9}$
	$\frac{2}{3}$	$\frac{2}{5}$	$4\frac{1}{2}$	$\frac{1}{2}$	$1\frac{7}{8}$	$\frac{7}{9}$	$\frac{1}{2}$
VI. 1.	$2\frac{3}{4}$	$9\frac{7}{8}$	$6\frac{3}{8}$	$9\frac{7}{12}$	$7\frac{5}{9}$	$4\frac{5}{6}$	$3\frac{7}{8}$
	$\frac{1}{6}$	$4\frac{5}{6}$	$4\frac{5}{6}$	$4\frac{5}{8}$	$2\frac{5}{6}$	$\frac{7}{10}$	$\frac{1}{6}$
2.	$8\frac{9}{10}$	$6\frac{5}{8}$	$9\frac{8}{9}$	$3\frac{11}{12}$	$4\frac{3}{10}$	$6\frac{3}{10}$	$4\frac{5}{6}$
	$4\frac{1}{4}$	$1\frac{7}{12}$	$4\frac{5}{6}$	$\frac{5}{8}$	$\frac{5}{6}$	$\frac{3}{4}$	$7\frac{7}{9}$
VII. 1.	$3\frac{1}{2}$	$8\frac{1}{4}$	$6\frac{5}{12}$	$9\frac{1}{8}$	$2\frac{1}{2}$	$8\frac{3}{4}$	$9\frac{1}{4}$
	$4\frac{5}{6}$	$5\frac{3}{8}$	$\frac{3}{4}$	$\frac{7}{16}$	$\frac{3}{4}$	7	$2\frac{1}{2}$
2.	$14\frac{1}{8}$	$5\frac{1}{4}$	$6\frac{3}{8}$	$3\frac{2}{3}$	$7\frac{5}{9}$	$7\frac{4}{5}$	$17\frac{2}{3}$
	$9\frac{1}{4}$	$4\frac{7}{12}$	$9\frac{7}{16}$	$6\frac{1}{2}$	$4\frac{2}{3}$	$8\frac{1}{2}$	$1\frac{7}{12}$
	$27\frac{1}{2}$	13	$14\frac{1}{2}$	$9\frac{1}{6}$	$6\frac{8}{9}$	$6\frac{3}{10}$	$19\frac{1}{2}$

VIII. 1.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
	$5\frac{2}{3}$	$9\frac{1}{8}$	$4\frac{1}{8}$	$4\frac{5}{6}$	$7\frac{2}{3}$	$7\frac{1}{4}$	11
	$\frac{3}{4}$	$\frac{3}{4}$	9	$3\frac{7}{9}$	$1\frac{5}{6}$	$\frac{1}{6}$	$2\frac{3}{8}$
	$7\frac{1}{6}$	$2\frac{5}{6}$	$2\frac{5}{6}$	$8\frac{1}{2}$	$\frac{8}{9}$	$15\frac{1}{2}$	$6\frac{1}{6}$
2.	$\frac{3}{8}$	$5\frac{3}{4}$	$9\frac{1}{4}$	$2\frac{3}{8}$	$5\frac{7}{10}$	$1\frac{4}{9}$	$8\frac{1}{10}$
	$\frac{2}{3}$	$6\frac{2}{3}$	$2\frac{5}{6}$	$\frac{1}{6}$	$\frac{3}{5}$	$5\frac{1}{6}$	$4\frac{1}{2}$
	$4\frac{1}{2}$	$7\frac{1}{8}$	$4\frac{2}{3}$	$7\frac{3}{4}$	$2\frac{1}{4}$	$3\frac{1}{2}$	$\frac{3}{4}$

Subtraction of Fractions

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
I. 1.	$\frac{7}{8}$	$\frac{5}{6}$	$\frac{7}{8}$	$\frac{9}{12}$	$8\frac{1}{2}$	$9\frac{5}{6}$	$14\frac{7}{9}$
	$\frac{1}{2}$	$\frac{2}{3}$	$\frac{3}{4}$	$\frac{2}{3}$	$5\frac{1}{4}$	$1\frac{2}{3}$	$5\frac{2}{3}$
2.	$\frac{1}{6}$	$\frac{1}{2}$	$\frac{9}{10}$	$\frac{7}{8}$	$17\frac{1}{2}$	$13\frac{3}{4}$	$14\frac{3}{8}$
	$\frac{3}{8}$	$\frac{5}{6}$	$\frac{1}{5}$	$\frac{5}{16}$	$9\frac{1}{8}$	$7\frac{1}{2}$	$5\frac{1}{16}$
II. 1.	$\frac{5}{6}$	$\frac{5}{6}$	$\frac{7}{2}$	$\frac{1}{12}$	$19\frac{5}{6}$	$6\frac{9}{10}$	$7\frac{5}{12}$
	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{1}{4}$	$11\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}$
2.	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{12}$	$\frac{1}{12}$	$9\frac{1}{2}$	$17\frac{1}{3}$	$11\frac{3}{4}$
	$\frac{1}{6}$	$\frac{1}{10}$	$\frac{2}{3}$	$\frac{3}{4}$	$4\frac{1}{10}$	$9\frac{1}{12}$	$8\frac{1}{12}$
III. 1.	$\frac{3}{4}$	$\frac{2}{3}$	$\frac{5}{6}$	$\frac{7}{8}$	$9\frac{1}{2}$	$11\frac{3}{4}$	$17\frac{1}{4}$
	$\frac{1}{5}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{5}{6}$	$2\frac{1}{3}$	$4\frac{2}{3}$	$9\frac{1}{6}$
2.	$\frac{5}{6}$	$\frac{5}{6}$	$\frac{7}{10}$	$\frac{4}{5}$	$9\frac{1}{3}$	$5\frac{3}{4}$	$1\frac{4}{5}$
	$\frac{5}{8}$	$\frac{5}{9}$	$\frac{1}{4}$	$\frac{2}{3}$	$9\frac{1}{4}$	$\frac{2}{3}$	$\frac{1}{2}$
IV. 1.	9	6	7	1	11	15	14
	$4\frac{3}{4}$	$5\frac{2}{3}$	$\frac{2}{3}$	$\frac{5}{6}$	$4\frac{7}{8}$	$9\frac{5}{7}$	$7\frac{8}{9}$
2.	17	1	14	12	13	15	16
	$9\frac{4}{5}$	$1\frac{1}{2}$	$8\frac{1}{2}$	$5\frac{4}{9}$	$3\frac{1}{6}$	$5\frac{1}{2}$	$4\frac{1}{4}$

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
V. 1.	$6\frac{1}{4}$	$8\frac{1}{3}$	$7\frac{1}{6}$	$6\frac{4}{9}$	$9\frac{1}{8}$	$17\frac{1}{5}$	$7\frac{1}{2}$
	$\underline{2\frac{3}{4}}$	$\underline{5\frac{2}{3}}$	$\underline{4\frac{5}{6}}$	$\underline{5\frac{7}{9}}$	$\underline{4\frac{5}{8}}$	$\underline{9\frac{4}{5}}$	$\underline{4\frac{1}{2}}$
2.	$11\frac{3}{8}$	$12\frac{1}{12}$	$9\frac{5}{16}$	$13\frac{7}{8}$	$9\frac{5}{9}$	$11\frac{3}{8}$	$14\frac{9}{16}$
	$\underline{9\frac{5}{8}}$	$\underline{5\frac{7}{12}}$	$\underline{4\frac{11}{16}}$	$\underline{4\frac{15}{16}}$	$\underline{8\frac{8}{9}}$	$\underline{9\frac{7}{8}}$	$\underline{7\frac{1}{16}}$
VI. 1.	$7\frac{1}{2}$	$9\frac{2}{3}$	$10\frac{3}{4}$	$7\frac{5}{12}$	$9\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{1}{2}$
	$\underline{4\frac{3}{4}}$	$\underline{\frac{5}{6}}$	$\underline{1\frac{7}{8}}$	$\underline{\frac{5}{6}}$	$\underline{\frac{15}{16}}$	$\underline{\frac{11}{12}}$	$\underline{\frac{5}{6}}$
2.	$9\frac{1}{4}$	$12\frac{5}{6}$	$13\frac{1}{2}$	$2\frac{1}{2}$	$1\frac{1}{2}$	$14\frac{1}{10}$	$6\frac{1}{6}$
	$\underline{8\frac{1}{2}}$	$\underline{4\frac{11}{12}}$	$\underline{4\frac{13}{16}}$	$\underline{1\frac{7}{8}}$	$\underline{\frac{7}{10}}$	$\underline{7\frac{2}{5}}$	$\underline{\frac{5}{12}}$
VII. 1.	$2\frac{1}{2}$	$1\frac{1}{4}$	$14\frac{1}{2}$	$6\frac{2}{3}$	$9\frac{1}{2}$	$1\frac{1}{3}$	$14\frac{2}{3}$
	$\underline{1\frac{2}{3}}$	$\underline{\frac{1}{3}}$	$\underline{7\frac{2}{3}}$	$\underline{5\frac{3}{4}}$	$\underline{7\frac{4}{5}}$	$\underline{\frac{3}{4}}$	$\underline{7\frac{4}{5}}$
2.	$7\frac{1}{5}$	$8\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{1}{3}$	$15\frac{1}{9}$	$13\frac{1}{2}$	$14\frac{4}{9}$
	$\underline{6\frac{3}{4}}$	$\underline{7\frac{4}{5}}$	$\underline{\frac{4}{5}}$	$\underline{\frac{2}{5}}$	$\underline{7\frac{1}{2}}$	$\underline{5\frac{7}{9}}$	$\underline{8\frac{1}{2}}$
VIII. 1.	$12\frac{3}{4}$	$9\frac{1}{6}$	$11\frac{3}{8}$	$1\frac{5}{6}$	$12\frac{1}{9}$	$14\frac{1}{6}$	$13\frac{5}{8}$
	$\underline{4\frac{5}{6}}$	$\underline{2\frac{3}{4}}$	$\underline{1\frac{5}{6}}$	$\underline{\frac{7}{8}}$	$\underline{3\frac{5}{6}}$	$\underline{2\frac{7}{9}}$	$\underline{\frac{11}{12}}$
2.	$15\frac{1}{4}$	$8\frac{1}{10}$	$9\frac{1}{6}$	$16\frac{7}{10}$	$13\frac{1}{10}$	$12\frac{1}{10}$	$1\frac{1}{6}$
	$\underline{4\frac{7}{10}}$	$\underline{2\frac{3}{4}}$	$\underline{4\frac{7}{10}}$	$\underline{7\frac{5}{6}}$	$\underline{8\frac{1}{6}}$	$\underline{9\frac{1}{4}}$	$\underline{\frac{7}{8}}$

Multiplication of Fractions

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
I. 1.	$\frac{3}{4} \times 5$	$\frac{7}{8} \times 9$	$\frac{5}{6} \times 7$	$\frac{2}{3} \times 8$	$\frac{1}{8} \times 3$
2.	$\frac{2}{5} \times 2$	$\frac{4}{5} \times 12$	$\frac{9}{10} \times 3$	$\frac{3}{7} \times 16$	$\frac{2}{3} \times 26$
3.	$\frac{1}{2} \times 57$	$\frac{2}{3} \times 95$	$\frac{3}{5} \times 27$	$\frac{1}{9} \times 8$	$\frac{5}{9} \times 50$
II. 1.	$\frac{3}{8} \times 12$	$\frac{5}{9} \times 6$	$\frac{7}{8} \times 20$	$\frac{5}{6} \times 15$	$\frac{7}{12} \times 30$
2.	$\frac{9}{16} \times 24$	$\frac{5}{16} \times 50$	$\frac{7}{10} \times 25$	$\frac{1}{6} \times 40$	$\frac{8}{9} \times 60$
3.	$\frac{3}{4} \times 26$	$\frac{3}{10} \times 36$	$\frac{7}{12} \times 45$	$\frac{5}{6} \times 75$	$\frac{3}{8} \times 50$
III. 1.	$6 \times \frac{5}{12}$	$9 \times \frac{7}{15}$	$8 \times \frac{1}{4}$	$12 \times \frac{3}{4}$	$56 \times \frac{7}{8}$
2.	$24 \times \frac{5}{16}$	$18 \times \frac{5}{6}$	$30 \times \frac{1}{10}$	$15 \times \frac{5}{6}$	$24 \times \frac{8}{9}$
3.	$12 \times \frac{7}{8}$	$20 \times \frac{5}{8}$	$15 \times \frac{7}{12}$	$36 \times \frac{3}{8}$	$48 \times \frac{11}{16}$

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
IV. 1.	$2\frac{1}{2} \times 14$	$3\frac{1}{4} \times 50$	$7\frac{2}{3} \times 18$	$9\frac{5}{6} \times 27$	$8\frac{1}{4} \times 50$
2.	$4\frac{1}{4} \times 26$	$3\frac{7}{8} \times 48$	$5\frac{1}{6} \times 45$	$7\frac{1}{3} \times 42$	$5\frac{1}{4} \times 18$
3.	$4\frac{3}{8} \times 60$	$11\frac{1}{2} \times 35$	$6\frac{7}{8} \times 36$	$5\frac{3}{8} \times 38$	$9\frac{1}{2} \times 56$

V. 1.	$\frac{2}{3} \times \frac{1}{5}$	$\frac{4}{5} \times \frac{3}{7}$	$\frac{5}{6} \times \frac{7}{8}$	$\frac{1}{2} \times \frac{9}{10}$	$\frac{3}{4} \times \frac{9}{16}$
2.	$\frac{1}{4} \times \frac{5}{8}$	$\frac{2}{3} \times \frac{7}{9}$	$\frac{5}{8} \times \frac{5}{9}$	$\frac{1}{6} \times \frac{1}{4}$	$\frac{2}{3} \times \frac{5}{7}$
3.	$\frac{7}{9} \times \frac{5}{6}$	$\frac{1}{9} \times \frac{1}{3}$	$\frac{3}{4} \times \frac{9}{16}$	$\frac{1}{2} \times \frac{11}{16}$	$\frac{5}{8} \times \frac{9}{16}$

VI. 1.	$\frac{2}{3} \times \frac{3}{4}$	$\frac{5}{6} \times \frac{9}{10}$	$\frac{3}{4} \times \frac{8}{9}$	$2\frac{1}{2} \times \frac{7}{10}$	$1\frac{1}{4} \times \frac{6}{7}$
2.	$\frac{7}{9} \times \frac{3}{4}$	$\frac{5}{8} \times \frac{4}{5}$	$2\frac{3}{4} \times \frac{8}{11}$	$\frac{5}{6} \times 2\frac{1}{4}$	$5\frac{1}{3} \times \frac{7}{8}$
3.	$\frac{1}{4} \times \frac{8}{9}$	$1\frac{1}{2} \times \frac{3}{4}$	$\frac{1}{10} \times \frac{5}{8}$	$1\frac{1}{8} \times \frac{8}{9}$	$\frac{5}{12} \times 5\frac{1}{4}$

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
VII. 1.	$5\frac{1}{4} \times 6\frac{2}{3}$	$7\frac{2}{3} \times 8\frac{1}{4}$	$1\frac{1}{2} \times 2\frac{1}{4}$	$5\frac{1}{4} \times 4\frac{1}{9}$
2.	$2\frac{1}{2} \times 2\frac{1}{2}$	$3\frac{1}{3} \times 4\frac{1}{2}$	$5\frac{1}{4} \times 3\frac{1}{7}$	$2\frac{3}{8} \times 1\frac{1}{3}$
3.	$6\frac{1}{4} \times 4\frac{2}{5}$	$12\frac{1}{2} \times 3\frac{1}{10}$	$3\frac{1}{7} \times 8\frac{3}{4}$	$6\frac{7}{8} \times 2\frac{4}{11}$

	<i>a</i>	<i>b</i>	<i>c</i>
VIII. 1.	$2\frac{1}{2} \times 3\frac{1}{4} \times 6$	$8 \times 1\frac{1}{3} \times 2\frac{5}{6}$	$7\frac{1}{2} \times 3 \times 4\frac{2}{3}$
2.	$1\frac{1}{4} \times 5 \times 6\frac{7}{8}$	$3\frac{1}{2} \times 1\frac{1}{4} \times 4\frac{1}{2}$	$9 \times 1\frac{5}{6} \times 2\frac{1}{2}$
3.	$2\frac{1}{4} \times 2 \times \frac{3}{8}$	$\frac{5}{8} \times 1\frac{1}{4} \times 1\frac{1}{3}$	$3\frac{1}{7} \times 2\frac{1}{2} \times 1\frac{3}{4}$

Division of Fractions

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
I. 1.	$\frac{1}{2} \div 2$	$\frac{2}{3} \div 3$	$\frac{3}{4} \div 5$	$\frac{7}{8} \div 2$	$\frac{9}{10} \div 2$
2.	$\frac{3}{7} \div 2$	$\frac{3}{10} \div 4$	$\frac{6}{7} \div 5$	$\frac{1}{8} \div 3$	$\frac{3}{4} \div 2$
3.	$\frac{1}{9} \div 2$	$\frac{8}{9} \div 3$	$\frac{11}{12} \div 2$	$\frac{5}{16} \div 2$	$\frac{1}{16} \div 3$
II. 1.	$\frac{3}{8} \div 3$	$\frac{4}{7} \div 2$	$\frac{5}{9} \div 5$	$\frac{6}{7} \div 3$	$\frac{9}{10} \div 3$
2.	$\frac{6}{7} \div 4$	$\frac{8}{9} \div 6$	$\frac{9}{10} \div 6$	$\frac{8}{11} \div 4$	$\frac{9}{16} \div 3$
3.	$\frac{3}{7} \div 3$	$\frac{4}{9} \div 6$	$\frac{10}{11} \div 5$	$\frac{7}{8} \div 7$	$\frac{5}{6} \div 10$
III. 1.	$12 \div \frac{2}{3}$	$12 \div \frac{3}{4}$	$18 \div \frac{3}{8}$	$9 \div \frac{1}{2}$	$7 \div \frac{1}{6}$
2.	$11 \div \frac{3}{4}$	$8 \div \frac{5}{6}$	$7 \div \frac{2}{3}$	$6 \div \frac{3}{8}$	$10 \div \frac{3}{4}$
3.	$36 \div \frac{3}{4}$	$96 \div \frac{8}{9}$	$9 \div \frac{3}{4}$	$21 \div \frac{3}{7}$	$15 \div \frac{2}{3}$
IV. 1.	$\frac{2}{3} \div \frac{5}{8}$	$\frac{3}{4} \div \frac{4}{9}$	$\frac{1}{2} \div \frac{3}{5}$	$\frac{2}{3} \div \frac{5}{8}$	$\frac{3}{4} \div \frac{2}{9}$
2.	$\frac{9}{10} \div \frac{5}{7}$	$\frac{5}{6} \div \frac{6}{7}$	$\frac{3}{5} \div \frac{4}{9}$	$\frac{1}{3} \div \frac{1}{2}$	$\frac{1}{2} \div \frac{1}{3}$

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
V. 1.	$6 \div 1\frac{1}{3}$	$7 \div 3\frac{1}{2}$	$9 \div 4\frac{1}{2}$	$1 \div 2\frac{1}{2}$	$14 \div 2\frac{1}{3}$
2.	$2 \div 1\frac{1}{2}$	$8 \div 4\frac{1}{4}$	$12 \div 2\frac{2}{5}$	$36 \div 3\frac{1}{4}$	$15 \div 3\frac{3}{4}$
3.	$1 \div 3\frac{1}{3}$	$60 \div 6\frac{2}{3}$	$28 \div 3\frac{1}{7}$	$40 \div 3\frac{1}{3}$	$5 \div 1\frac{1}{4}$

VI. 1.	$1\frac{1}{2} \div 2\frac{1}{4}$	$2\frac{1}{3} \div 4\frac{2}{3}$	$9\frac{1}{6} \div 3\frac{1}{2}$	$8\frac{1}{4} \div 1\frac{7}{8}$	$5\frac{1}{9} \div 1\frac{1}{3}$
2.	$4\frac{1}{2} \div 2\frac{1}{4}$	$6\frac{1}{2} \div 3\frac{1}{7}$	$9\frac{1}{4} \div 2\frac{1}{8}$	$5\frac{1}{3} \div 2\frac{2}{3}$	$1\frac{7}{8} \div 2\frac{1}{2}$
3.	$9\frac{1}{3} \div 5\frac{1}{6}$	$8\frac{1}{2} \div 4\frac{1}{4}$	$15\frac{1}{3} \div 1\frac{1}{6}$	$12\frac{1}{2} \div 1\frac{2}{3}$	$7\frac{1}{3} \div 1\frac{3}{4}$

VII. 1.	$3 \div 4$	$5 \div 6$	$7 \div 8$	$9 \div 12$	$15 \div 30$
2.	$1 \div 8$	$7 \div 10$	$5 \div 15$	$24 \div 36$	$48 \div 72$

Addition of Decimals

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>
I. 1.	.3	.1	.1	.7	.3	.2	.1	.5	.8	.5	.6	.4
	.8	.2	.2	.4	.9	.6	.3	.4	.6	.9	.8	.3
	.6	.1	.1	.6	.5	.7	.2	.7	.9	.4	.6	.5
	.7	.3	.2	.9	.4	.9	.4	.4	.2	.3	.5	.9

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
II. 1.	.03	.01	.02	.48	.30	.40	.38	.47	.29
	.05	.02	.04	.28	.50	.60	.27	.23	.38
	.06	.01	.01	.36	.70	.70	.54	.56	.54
	.07	.04	.03	.16	.50	.90	.96	.84	.72

III. 1.	5.6	0.8	3.9	9.1	3.1	7.2	3.5	4.0	1.5
	4.3	7.6	0.8	7.4	0.4	2.8	4.8	1.9	0.5
	7.2	3.1	7.4	5.8	0.9	5.4	1.2	7.3	2.0
	9.4	1.5	5.2	6.7	0.6	9.7	0.9	5.5	3.5

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
IV. 1.	4.32	2.60	5.65	5.28	.450	.426	1.46	.743
	1.56	0.90	1.78	3.76	.390	.380	2.70	.192
	9.38	7.30	8.46	1.45	.545	.725	9.88	.085
	6.27	2.80	3.27	0.87	.025	.940	5.07	.388
	5.34	1.50	0.96	6.20	.790	.385	3.96	.959

Subtraction of Decimals

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
I. 1.	.45	.53	.90	.50	.31	.90	.80	.625	.600
	<u>.25</u>	<u>.18</u>	<u>.45</u>	<u>.46</u>	<u>.15</u>	<u>.57</u>	<u>.73</u>	<u>.145</u>	<u>.492</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
II. 1.	3.4	5.0	7.2	9.4	5.3	6.8	1.0	5.4	6.0
	<u>1.2</u>	<u>1.6</u>	<u>6.2</u>	<u>8.6</u>	<u>4.7</u>	<u>1.9</u>	<u>0.3</u>	<u>1.9</u>	<u>5.9</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
III. 1.	7.20	3.00	1.00	5.40	9.05	4.50	7.61	3.80	8.04
	<u>4.85</u>	<u>1.90</u>	<u>0.39</u>	<u>0.78</u>	<u>8.05</u>	<u>4.39</u>	<u>2.59</u>	<u>3.76</u>	<u>7.96</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
IV. 1.	4.90	3.00	9.56	2.75	5.46	1.730	2.840
	<u>1.09</u>	<u>2.75</u>	<u>1.56</u>	<u>2.75</u>	<u>2.86</u>	<u>0.930</u>	<u>1.940</u>
2.	7.00	3.04	7.36	1.01	12.38	13.450	14.325
	<u>4.01</u>	<u>2.94</u>	<u>1.89</u>	<u>0.99</u>	<u>4.96</u>	<u>7.580</u>	<u>8.105</u>

Multiplication of Decimals

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
I. 1.	.47	.58	3.6	5.8	.96	.78	.89	9.4	3.4
	<u>2</u>	<u>5</u>	<u>4</u>	<u>9</u>	<u>8</u>	<u>3</u>	<u>6</u>	<u>7</u>	<u>8</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
II. 1.	.01	.07	.04	.07	3.01	4.02	7.04	9.03	6.07
	<u>9</u>	<u>8</u>	<u>7</u>	<u>9</u>	<u>4</u>	<u>6</u>	<u>5</u>	<u>8</u>	<u>9</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
III. 1.	76	38	25	68	43	57	78	96	39
	<u>.4</u>	<u>.9</u>	<u>.4</u>	<u>.7</u>	<u>.5</u>	<u>.6</u>	<u>.5</u>	<u>.04</u>	<u>.08</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
2.	13	49	56	94	75	460	380	965	430
	<u>.07</u>	<u>.08</u>	<u>.05</u>	<u>.08</u>	<u>.06</u>	<u>.05</u>	<u>.04</u>	<u>.07</u>	<u>.09</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
IV. 1.	6.2	5.4	2.5	9.6	5.8	9.6	43.7	5.38	37.5
	<u>3.8</u>	<u>2.5</u>	<u>2.5</u>	<u>4.7</u>	<u>1.3</u>	<u>2.1</u>	<u>4.8</u>	<u>2.6</u>	<u>8.4</u>

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>
2.	2.9	6.4	3.9	5.5	7.26	6.04	50.5	3.12	5.39
	<u>2.9</u>	<u>5.8</u>	<u>1.9</u>	<u>3.4</u>	<u>1.8</u>	<u>3.5</u>	<u>9.6</u>	<u>1.7</u>	<u>2.8</u>

V.	1.	.84	.75	3.8	5.04	.39	.06	.025	.035	8.35
		<u>.02</u>	<u>.04</u>	<u>.04</u>	<u>.07</u>	<u>.02</u>	<u>.04</u>	<u>.25</u>	<u>.35</u>	<u>.57</u>
2.		.09	.16	.15	.14	.56	3.01	8.75	4.56	.736
		<u>.01</u>	<u>.16</u>	<u>.15</u>	<u>.08</u>	<u>.04</u>	<u>.19</u>	<u>.65</u>	<u>.028</u>	<u>.095</u>

VI. Multiply each of the following by 10, 100, and 1000:

	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>
1.	3.5	7.86	.946	.035	72.6	.548	.0755	1.05
2.	.001	5.4	7.86	.009	.078	3.56	4.25	0.38

Division of Decimals

I.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1.	6)9.6	7)12.6	2)9.2	8)3.28	5)4.45
2.	4)13.6	9)2.16	7).84	6)39.54	8)1.384

II. 1.	3).216	2).196	4).376	5).1375	9).4806
2.	7).294	8).608	7).1337	4).092	8).096

III. 1.	.3)72	.5)40	.7)91	.6)84	.9)126
2.	.2)98	.3)57	.5)67	.8)124	.4)78

IV.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
1.	.02)31	.03)51	.05)18	.07)567	.15)225
2.	.08)37	.09)162	.48)2256	.75)3150	.54)2592

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	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>
V. 1.	.2)9.4	.3)54	.6)912	.8)1.28	.9)729
2.	.3)8.1	.8)624	.5)0295	.4)7.6	.7)0644
3.	.02)58	.06)3.48	.15)645	.24)408	.45)166.5
4.	.01)9.8	.08)1.2	.14)532	.36)1.368	.64)2112

VI. 1.	12)06	18)09	75)03	16)8	36)018
2.	25)08	15)006	14)7	75)6	35)014
3.	16)12	36)27	38)019	54)27	34)051

VII.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
1.	4)3	8)1	5)3	4)1	8)3	5)4	16)1
2.	8)7	2)1	36)27	12)9	16)10	24)18	25)4
3.	25)9	40)11	20)17	24)9	14)7	26)13	25)24

VIII.	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>
1.	1.6)336	.34)0918	4.6)119.6	.64)1.728
2.	4.8)18.24	.75)352.5	2.7)0999	6.9)248.4
3.	.18)0882	3.6)1656	8.3)3901	.94)441.8
4.	7.6)3.496	.48)2256	1.7)0816	.12)0588
5.	.19)0912	.37)177.6	.55)3685	.42)3108

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